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Sport Fishery Abstracts

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Sport Fishery Abstracts

An abstracting service for fishery research and management

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

The symbol (A) following an abstract indicates an author's abstract. Other initials following the abstract are those of abstractors whose names are listed on the last page. If no symbol is given the abstract was prepared by the Editorial staff. One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
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584. Slack, Keith Vollmer. 1955. A STUDY OF THE FACTORS AFFECTING STREAM PRODUCTIVITY BY THE COMPARATIVE METHOD. Investigations of Indiana Lakes and Streams, Vol. 4, Oct., pp. 3-47.

The gradual accumulation of information about the physical, chemical, and biological characteristics of streams has led to the general concept that the biological productivity of streams depends in part upon the supply of nutrients to the water and in part upon physical factors. The present work is an attempt to verify this concept by a comprehensive study of the quantitative differences of the biota, the chemistry of the water, and various physical features of two small streams.

The streams were selected on the basis of their physiographic location on the assumption that the composition of the bedrock greatly influences the character of streams. The watershed of Jacks Defeat Creek, about 6 miles west of Bloomington, Indiana, drains a limestone region and maintains a relatively constant flow. The stream bottom is composed of limestone and chert fragments which maintain an angular shape. This characteristic of the rock insures a stable bottom for the support of sessile plants and bottom communities. In contrast, Brummetts Creek, about 5 miles east of Bloomington, is a less stable environment. The creek drains an area of impervious sandstone and shale and becomes pooled up in late summer and fall. The exposed rocks of the stream bottom are shattered by alternate freezing and thawing, and rounded fragments of gravel size are easily shifted by the current. Water level, discharge, water temperature, and morphometry of the drainage basins were other physical features investigated.

The two streams were distinctly different in their chemical characteristics. Jacks Defeat Creek regularly contained higher concentrations of mineral nutrients than did Brummetts Creek. The total alkalinity of the former stream was about 80 ppm. and of the latter about 18 ppm. Nitrate was from five to ten times greater in Jacks Defeat Creek than in Brummetts Creek, varying from about 0.1 to 1.0 ppm. in both streams. Phosphate paralleled nitrate, and was from two to eight times greater in Jacks Defeat Creek. Phosphate ranged from a trace to 0.025 ppm. in the two streams. Chloride followed much the same pattern. Chemical differences between the streams showed up at all seasons of the year and at all stations from headwaters to mouth. Dissolved oxygen, pH, free carbon dioxide, and nitrate were also measured.

Quantitative studies were made of the standing crops of crayfishes and other benthic organisms. The crayfish fauna was greater in Jacks Defeat Creek (2.2 grams of organic matter per square meter) than in Brummetts Creek (1.3 grams of organic matter per square meter). A similar relationship applied to the quantity of other benthic organisms. Jacks Defeat Creek had 6.1 grams of organic matter per square meter and Brummetts Creek had 0.6 grams per square meter. The growth in length of longear sunfish was greater in the former creek with a mean growth rate of 19.9 mm. per year in contrast to 16.4 mm. per year in Brummetts Creek.

The quantitative biological differences in the streams seem to be a true reflection of the quantity and quality of mineral nutrients present in the water and the stability of the physical environment. Since the physical and chemical properties of streams are determined by the physiographic location, future work on the basic nature of stream productivity should include the whole watershed rather than just the flow of surface water. (A)

585. Gerking, Shelby D. 1955. KEY TO THE FISHES OF INDIANA. Investigations of Indiana Lakes and Streams, Vol. 4, Oct., pp. 49-86.

This key to the fishes of Indiana is presented to supplement the knowledge of the State's fauna and to provide additional help for students of mid-western fishes in general. All of Indiana's 172 species are included in the key. The species are arranged in 29 families and 71 genera.

Petromyzon marinus and Carpiodes forbesi have been discovered recently in the State, and these are the only additions to the State list since 1945. Changes in nomenclature are presented as well as an annotated list of significant new distribution records for various species. (A)

586. Riggs, Carl D. 1955. REPRODUCTION OF THE WHITE BASS, MORONE CHRYSOPS. Investigations of Indiana Lakes and Streams, Vol. 4, Oct., pp. 87-110.

The reproduction of the white bass, Morone chrysops, was studied at two impoundments: Shafer Lake, White County, Indiana, during the springs of 1945 through 1947; and Lake Texoma, Oklahoma and Texas, 1949 through 1952. This species, generally distributed throughout the Mississippi and Great Lakes drainages, inhabits larger rivers, impoundments, and lakes within its natural range. Its range is being enlarged by stocking, and its center of abundance is shifting from the Great Lakes drainage to the Middle and Lower Mississippi drainage, chiefly due to the construction of impoundments and further stocking. Male white bass mature younger and at a smaller size than females. The reproduction cycle is annual. In each year males ripen much earlier than females, some males ripening to the point of sperm emission by late October. Females were never found in a comparable stage of ripeness until the time of spawning. Spawning occurred over firm-bottom areas; in Shafer Lake in tributary streams or the headwaters where the water was 2 to 4 feet deep and in Lake Texoma over shoals in water of comparable depth. Sexually mature white bass formed large unisexual schools each spring when the water temperature rose to 55° and 60° F. The male schools migrated to the spawning grounds and remained there until the arrival of the fully-ripe females some time later. Spawning then occurred. Males fought among themselves, and both sexes fed during the migrations. The reported spawning

period throughout the range of the species is April through June, at water temperatures ranging from 58° to 75° F. At any one locality the total spawning period apparently lasts from 5 to 10 days, and spawning occurs both day and night.

White bass are gregarious during spawning, and the males outnumber the females at the spawning areas. Several males surround a female during the spawning act, and this group swims rapidly and erratically around, scattering the demersal eggs at or near the surface. They are fertilized as they sink, and being adhesive they stick to gravel, rocks, vegetation, snags, etc. As soon as the fish are spent they return to the deeper waters of the lake.

Although the number of eggs actually laid is unknown, the average number of eggs in the ovaries of 14 ripe females was 565,000; the range—241,000 to 933,000. The average diameter of 100 eggs was 0.81 millimeter. They have been propagated in Chase jars and hatched in 46 hours at 60° F. (A)

587. Davis, Claude S. 1955. THE INJECTION OF LATEX SOLUTION AS A FISH MARKING TECHNIQUE. Investigations of Indiana Lakes and Streams, Vol. 4, Oct., pp. 111-116.

Carmine, India ink, liquid plastic, alizarin and liquid latex were injected subdermally with a hypodermic syringe into various species of fishes. India ink faded in a relatively short time, and alizarin spread to areas surrounding the injection site. The acetone solvent in liquid plastic caused erosion of the flesh and loss of the mark. Carmine proved to be a successful mark for a limited period of observation and should be investigated further.

Of the various substances tried liquid latex was found to be most promising because it is water soluble, it solidifies upon standing, it is flexible, and it produces no adverse physiological effect. Latex can be purchased in various colors, and a wide variety of color variations can be made by mixing the basic colors.

Blue and yellow latex were more easily identifiable than red latex on green sunfish. The red color appeared to fade slightly, but this appearance may have been due to the color background of the fish. These marks lasted from six to ten months, under both laboratory and natural conditions.

The most successful mark was accomplished by using a veterinary syringe. The needle was inserted beneath a scale and underneath the skin. A spot of latex was forced from the syringe and the needle withdrawn from the puncture. The scale then forms a water-tight seal when the fish is released into the water. (A)

588. Ricker, W. E. 1955. FISH AND FISHING IN SPEAR LAKE, INDIANA. Investigations of Indiana Lakes and Streams, Vol. 4, Oct., pp. 117-161.

Spear Lake, a glacial moraine lake of 40 acres, was studied during 1944-45 and again in 1947-49. The catch of fish varied from 44 to 68 lb. per acre, being greatest in 1945 and least in 1948. Over 90 percent of the fishing was by cane pole with live baits, and bluegills comprised more than half of the fish caught, by weight. Fishing was light during 1944 — 92 pole-hours per acre — but rose to three times that figure in 1945 and remained about the same in subsequent years. Average fishing success was 6.3 lb. per 10 pole-hours in 1944, and varied from 1.9 to 2.4 lb. per 10 hours in later years.

The estimated legal bluegill population of the lake varied from 600 in 1944-45 down to 310 fish per acre in 1948-49, or from 113 to 51 lb. per acre. The decrease was partly the direct result of more intensive fishing in 1947-49, but a much more important influence was a decrease in abundance of age III recruits in 1947-49, as compared with 1944 and 1945. These poorer year-classes of recruits were the progeny of the large adult populations of 1944 and 1945. Average rate of exploitation of legal-size bluegills was 27 percent in 1944 and 38-46 percent in 1945-49. However, fish of intermediate size were more vulnerable than average, and their rate of removal exceeded 50 percent during the latter period. Natural mortality of bluegills caused more deaths than did fishermen's efforts in the 1944 fishing season, and fewer than the fishing in the 1948-49 season. The instantaneous rate of natural mortality was about 0.78. Year-to-year survival of legal-size bluegills was estimated as 29 percent in 1944-45 and 17 percent in 1948-49.

The population of legal-size redear sunfish was about a third of that of the bluegills, and was fished almost as effectively. Redears were caught principally in spring. The legal largemouth bass population was 5-7 fish per acre, about a third of which were caught in a year. Among the minor species, warmouth, crappies and bullheads were less intensively exploited than bluegills and redears; pumpkinseeds were more intensively exploited but are of negligible importance. Of fish species not utilized by fishermen, nearly all existed only in small or inconsequential numbers. Lake chubsuckers were probably commonest, with a population of perhaps a few thousand. The dogfish (bowfin) population was estimated as 40-50. Carp were not seen. (A)

589. Frey, David G. 1955. DISTRIBUTIONAL ECOLOGY OF THE CISCO (COREGONUS ARTEDII) IN INDIANA. Investigations of Indiana Lakes and Streams, Vol. 4, Oct., pp. 177-228.

The cisco is known with considerable certainty to occur in 41 lakes of northern Indiana, of which Shriner Lake at a latitude of 41° 14' N. is the southernmost known natural occurrence of the family Coregonidae.

The species generally occurs in the deep water of a lake in summer. As oxygen conditions become progressively more severe, the population is forced into the upper part of the hypolimnion, and finally into the lower or even the upper part of the thermocline. The summer bathymetric distribution of the species in several Indiana lakes was determined by means of gill nets, and in the other lakes

it was inferred from the extremes of temperature-oxygen stratification of summer. Data available for 37 cisco lakes as compared with 53 non-cisco lakes demonstrate that in general the cisco lakes have a thicker stratum of water with temperatures below 20° and an oxygen content greater than 3 ppm. The shallower cisco lakes tend to have an oxygen maximum in the thermocline, and in one lake such a photosynthetic maximum has occurred regularly over four successive summers. This type of oxygen distribution is believed significant in enabling the species to survive in small and shallow lakes. (A)

590. Zippin, Calvin. 1956. AN EVALUATION OF THE REMOVAL METHOD OF ESTIMATING ANIMAL POPULATIONS. Biometrics, Vol. 12, No. 2, pp. 163-189.

The following topics are covered: development of a rapid graphical procedure for obtaining maximum likelihood estimates of population size from removal method data; determination of the asymptotic precision of the removal method; report on the results of experimental sampling which was conducted in order to compare the maximum likelihood estimates with estimates by an alternative regression method (Hayne, 1949) and to study the performance of the removal method on small populations; determination of the proportion of the total population which must be trapped in order to reduce the coefficient of variation of estimates of population size to specified levels; tests of the assumptions underlying the removal method and their application to actual trapping data. (VS)

591. Trefethen, Parker S. 1956. SONIC EQUIPMENT FOR TRACKING INDIVIDUAL FISH. U. S. Fish & Wildlife Serv., Spec. Sci. Rpt.--Fisheries No. 179, 11 pp.

Special sonic devices are being developed for obtaining detailed information on individual fish behavior. A miniature underwater sonic tag is attached to an adult salmon and the movements of the fish are observed on calibrated sonic receiving equipment. The position of the fish can be pinpointed, and movements plotted for periods of time up to 100 hours. The equipment can be used in varied hydraulic conditions and in fresh or salt water to track the movements of adult fish and other aquatic animals. The transducer is attached behind the dorsal fin of adult salmon by a nickel-chromium "hog-ring" clamped into the back with special pliers. It is attached underwater without handling or immobilizing the fish. Visual observations indicate that the transducer does not affect the natural movements of an adult salmon. (A)

592. Royce, William F. and Tamio Otsu. 1955. OBSERVATIONS OF SKIPJACK SCHOOLS IN HAWAIIAN WATERS, 1953. U. S. Fish & Wildlife Serv., Spec. Sci. Rpt.—Fisheries No. 147, May, 31 pp.

The purposes of this study were to evaluate and improve the scouting techniques and to determine the distribution of the skipjack (Katsuwonus pelamis).

Skipjack schools are located almost entirely by accompanying birds which flock and maneuver characteristically when working over them. A new method of estimating scanning efficiency indicates that only 6 percent of total flocks are seen beyond 2 miles, and 38 percent between 1 and 2 miles. Many flocks were missed. Careful scanning aft of the vessel on autumn cruises resulted in a 22 percent increase in number sighted. Numerous factors affecting the occurrence of flocks and the methods of sighting them were investigated. Poor weather conditions reduced the proportion of flocks seen. Large flocks were seen farther from the vessel than small ones. In April more flocks were seen in early morning and mid-afternoon: in June more just before noon and in the autumn they were randomly distributed during the day.

The Hawaiian fleet catches three-fourths of its skipjack within 20 miles of land, but schools are not more abundant there. There was no decline in abundance with distance from land out to 230 miles northeast and 350 miles southwest of Oahu. More schools were seen southwest of Oahu in February, September, October, and November; more to the northeast in April and June.

A peak in the seasonal cycle of number of schools seen occurred in April, not when the catch was greatest in June to August. It is shown that the schools observed in April contained smaller fish and the fishermen fished fewer of them. (A)

593. Moore, Harvey L. and H. William Newman. 1956. EFFECTS OF SOUND WAVES ON YOUNG SALMON. U. S. Fish & Wildlife Serv., Spec. Sci. Rpt—Fisheries No. 172, April, 19 pp.

The objective was to determine whether any quantity or quality of underwater sound would attract or repel young salmon. Frequencies from 5 to 20,000 cycles per second were tested in an experimental tank and in open water. Two types of transducers were used. Other than an initial "start" by the fish, no reaction was demonstrated. Apparently, fish are conditioned almost instantaneously to sounds. It was concluded that sound waves were ineffective as an attracting or repelling force. (A)

594. Schneller, Myrtle V. 1955. OXYGEN DEPLETION IN SALT CREEK, INDIANA. Investigations of Indiana Lakes and Streams, Vol. 4, Oct. pp. 163-175.

During low volume discharge in autumn, the amount of leaf fall into certain creeks in southern Indiana is great enough to cause them to develop an inky black color; and, at the same time, the oxygen content of the water declines to very low levels and the free carbon dioxide increases markedly. Only rarely, however, do these extreme chemical conditions cause mortality among the various species of fish in the creeks. (A)

595. Hnatevic, B. 1953. FISHING WITH ELECTRICITY. Bull. of the Czechoslovak Acad. of Agric. Sci., No. 1-2, pp. 101-109. (Translated and summarized by Dr. G. Mares)

The author reviews the many applications of electric fishing and the studies carried out in his country as well as in other countries, especially in Germany and Switzerland. He gives a detailed description of the instrument used by him in his experiments, which consists basically with two isolated cables. The shorter cable has a cathode (minus) electrode, i.e., a perforated zinc plate, placed in water. The second cable is rolled, 50 metres long. On its free end it is connected with the anode electrode, provided by a copper plate, installed on the top of a rod, the size of which is three metres. The electric current is effective when both electrodes are in the water. The cathode electrode has an irritating, sometimes even narcotizing effect, the anode electrode makes fishes turn and move toward the electrode (electrotaxis) until they become narcotized. The action radius of both electrodes is about 1.5 m., but the electronarcosis occurs only in the distance of about 50 cm. from the electrode. The intensity of the process depends on conductibility of water and also on how far the electrodes are located from each other.

The effects of the electric shock on different aquatic animals have been studied both in streams and ponds. The results of studies conducted: 1. In a direct current, 4 amp. and 400 volts, no immediate injuries or effects on vitality have been observed. 2. The sensitivity to the electric shock is different for every species; the greatest has been observed in the Thymallus thymallus, the next greatest in the trouts, the smallest in the Lota lota, and other species of lesser value. Usually fishes become normal after 30 minutes. Similar effects have been observed on salamanders, frogs, Gammarus pulex and Planaria nigra. 3. No changes in chemical composition of water occurred regarding 0_2 and pH.

596. Volf, Fr. 1953. INJURIES DONE TO TROUTS BY ELECTRIC FISHING. Bull. of the Czechoslovak Acad. of Agric. Sci., No. 1-2, pp. 104-109. (Translated from Czechoslovak and summarized by Dr. G. Mares.)

Electric fishing has become a common and very effective means of fishing mature trout for artificial spawning or of fishing of species of lesser value. As for the effects of the electronarcosis caused by the direct current, Suvorov indicates:

The minimum intensity arousing sensibility is 0.02-0.5 amp. on 1 cm^2 cross-section. The fish shows unrest. When the current is increased, the fish turns its head toward the electrode. Later on, it loses sensitivity for external mechanical impulses. Still later, it loses equilibrium, turns on its side or on its back, floats up to the surface, then sinks to the bottom, respiration slows up, and the fish may finally die. By disconnecting the current, the fish becomes normal in 3-5 minutes with no injuries sustained. When the intensity of the current is reduced, the electronarcotized fish comes quickly to life, but after a while loses sensitivity again. Similar physiological effects are described by the German researcher Schaperclaus for alternating current.

Experiments with direct current of 180-200 volts resulted in serious wounding of both the common trout and the Salmo irrideus. In these experiments the current was maintained at a steady intensity. The tension of the current was increased by locating the metallic ring (plus pole) outside of water, and the increased tension was communicated to the fish. After the first shock there is another and stronger one, when the fish is drawn out of the water. The nature of the wounds was rupture of vertebral column and injury of swim-bladder.

597. Chapman, D. G. and C. O. Junge, Jr. 1956. THE ESTIMATION OF THE SIZE OF A STRATIFIED ANIMAL POPULATION. The Ann. of Mathematical Statistics, Vol. 27, No. 2, June, pp. 375-389.

The estimation of the size of an animal population is considered for a situation where the population is stratified and only partial mixing takes place between strata. A consistent estimate is found and its variance determined. It is shown that estimates previously given or frequently used in this situation are not necessarily consistent and, in fact, may be meaningless. Conditions for their consistency are determined. Some further statistical problems in estimating the interstrata migration are discussed. (V.S.)

598. Rockwell, Julius, Jr. 1956. SOME EFFECTS OF SEA WATER AND TEMPERATURE ON THE EMBRYOS OF THE PACIFIC SALMON, ONCORHYNCHUS GORBUSCHA (WALBAUM) AND ONCORHYNCHUS KETA (WALBAUM). Dissertation Abstracts, Vol. 16, No. 5, p. 850.

Pink and chum salmon were shown to spawn naturally and successfully in the intertidal zone of the streams of Southeastern Alaska. Large collections of eggs in advanced stages of development were made from deep in the gravel where salt water was found to be present every high tide. Survival was found to be better in some intertidal levels than in those upstream.

To determine the effect of sea water on the eggs and larvae, laboratory experiments were conducted in which other variables were either controlled or closely observed. Each stage was separately studied, including fertilization, early and late eggs, hatching and larvae, using sea water salinities 0, 6, 12, 18, 24, and 30°/oo.

It was shown that sea water salinity 18°/oo and below does not inhibit fertilization and at salinity 30° /oo some fertilization could take place. Percentage fertilization at an isotonic concentration, salinity 12° /oo, was insignificantly superior to that in fresh water.

The resistance of eggs and larvae to sea water varied considerably between individuals. All

survived several days before succumbing to even the highest concentration (30°/oo). The concentration-time curves of 50 percent mortality were rectangular hyperbolae of the family $T = A(S-C)^{-B}$ where T = time, S = sea water salinity and where A, B, and C are constants. C is the concentration a given percent of the individuals survives indefinitely, and is definitely above zero. The value of C is considerably greater at lower temperatures than at higher ones for both eggs and larvae. However in the temperature range used (38° F. - 50° F.) larvae withstood higher concentrations than did eggs. Thus the highest tolerable condition needs be described by four coordinates: Concentration, time, temperature, and percent mortality.

Below concentration, C, survival was apparently superior to that in tap water (Ca 7 mg/kg) for eggs at low temperatures. Larvae in mild sea water exhibited definitely superior growth, survival, and activity, which were probably due to the salts in the sea water.

Also included is a complete review of available information on the intertidal spawning of salmon, analyses of allied work, a critical review of the principle of thermal summations as applied to fish eggs, and a description of a modification of the probit method to describe the four dimensional picture of the limit of tolerance.

The form of the concentration-time curve plus observations of the dessication of larvae in high concentrations indicate that death is due to water withdrawal, a process which can be reversed (if it has not gone too far) by a return to a more dilute environment. It may be concluded that sea water in the upper and middle intertidal zone does not appreciably contribute to the mortality of the eggs and larvae (immersed in it for short periods of time). (A)

599. Tibbles, John James Gowan. 1956. A STUDY OF THE MOVEMENTS AND DEPTH DISTRIBUTION OF THE PELAGIC FISHES IN LAKE MENDOTA. Dissertation Abstracts, Vol. 16, No. 5, p. 1022.

This study was initiated to extend our knowledge of the movements and depth distribution of the pelagic fishes (perch - Perca flavescens (Mitchill), white bass - Lepibema chrysops (Rafinesque) and cisco - Leucichthys artedi (LeSueur)) in Lake Mendota using the U. S. Navy (Submarine Signal Co.) NJ-9 (21.6 kc.) echo-sounder.

A method of cruising on pre-determined courses was devised so that the movements and areas of concentration of fishes could be ascertained by the echo-sounder. The rolling gill net was developed for confirming echoes recorded on the sonar gear that were attributed to fish and for depicting the depth distribution of the pelagic fishes. The net, supported on a metal float, when set forms a curtain of netting from surface to bottom 18 feet wide by 50 feet deep.

Various aspects of the use of sonar gear were investigated as: plotting concentrations of fish-echoes; echo-sounding through ice; recording a "surface" scattering layer; perch behaviour during the spawning period; recording fish attracted by light; correlating surface echoes with schooling white bass at the surface and corroborating bottom echoes as fish by means of a small otter trawl.

The NJ-9, a relatively low frequency, echo-sounder was most efficient in recording fish-echoes in the upper 35 feet of water. The concentration of fish at the Second Point shelf was in an area where there was a gradual drop in depth. These fish appeared to move in a westerly direction in the morning, over the gradually sloping shelf, away from the shelf and return in the evening. All of the fish did not participate in this movement because echoes (although substantially reduced) were recorded in the same area throughout the day. These perch remained quiescent on the bottom at night and were not recorded with the echo-sounder.

There appears to be at least three behavioural variations in sites of habitat for perch in Lake Mendota during the summer: 1. The littoral population composed of juvenile and mature perch. 2. The population (chiefly mature) on the west side of the Second Point Shelf characterized by the rhythmic daily movements described above. 3. The population of older perch found on the east side of the shelf that are active 24 hours a day.

The depth distribution of perch, white bass, cisco, gar pike - Lepisosteus osseus Rafinesque, and northern pike - Esox lucius Linnaeus, was determined for one area east of the underwater shelf at Second Point, from late summer to early spring by means of the rolling gill nets. Over 90 percent of the white bass were caught in the surface 20 feet, while over 90 percent of the perch were taken below 20 feet in water 54 feet in depth. From the varying depths that perch were caught during the summer it is apparent that they are not restricted to a definite temperature stratum. It appears that the pelagic population of perch in Lake Mendota remain in the deepest water in which there is sufficient oxygen to maintain life. (A)

600. Underhill, James Campbell. 1956. THE DISTRIBUTION OF SMALL STREAM FISHES IN MINNESOTA. INTRA-SPECIFIC VARIABILITY IN THE COMMON SHINER (NOTROPIS CORNUTUS), THE SAND SHINER (NOTROPIS DELICIOSUS), AND THE BIGMOUTH SHINER (NOTROPIS DORSALIS). Dissertation Abstracts, Vol. 16, No. 5, pp. 1022-1023.

Fishes were collected in the small streams tributary to the St. Croix, Minnesota, lower Mississippi and Missouri Rivers in Minnesota. A total of 100 collections were made in 1952, 1953 and 1954. The distribution of the 41 species of minnows and 14 species of darters, as well as one ameiurid and one sucker was discussed. In plotting the distribution, the collections at the University of Minnesota were used. Relative dates for migration were assigned to various groups of species based on the late and post Mankato chronology. Seventeen species of minnows and 3 species of darters were common to all drainage basins, while 13 species of minnows and 2 species of darters were restricted

to the lower Mississippi River basin. Biological evidence was presented which indicates that the upper Mississippi-St. Croix connection was open for a time following the closure of the Lake Duluth connection. Evidence was presented which indicates that there was no important barrier to fish dispersal in the St. Croix River. The upper St. Croix fauna includes 8 species of fish absent from the upper Mississippi River. Seven species of fishes common to the Minnesota River are absent from the Red River basin, indicating their migration in post Lake Agassiz-River Warren time. The distribution of only two species of minnows could not be explained on the basis of a lower Mississippi origin in post or late Mankato time. The distribution of the finescale dace and the creek northern chub, seem best explained on the basis of an eastern and western refugium in Wisconsin time. Following deglaciation the eastern populations expanded through the Great Lakes and western populations from the Alaskan refugia migrated eastward by way of Lake Agassiz. The distribution of all but one species of minnow could be explained in terms of late and post Mankato events. The above species, the stoneroller, has a rather restricted range in the upper Mississippi River and it is considered to be a recently introduced species, possibly in minnow dealers stocks. Ecological factors limiting fish distribution were discussed, but it was impossible to determine what the limiting factors might be, since essentially similar habitats were present in many of the drainage basins. Those species restricted to the lower Mississippi River were considered to indicate late migrations, rather than ecologically limited species, similar habitats occupied by these species in the lower Mississippi River wer to be found in the St. Croix and Minnesota Rivers.

Intraspecific variation in certain meristic characters in three species of small stream fishes were studied. The sand shiner, Notropis deliciosus, exhibited the least variation, the common shiner, Notropis cornutus, exhibited an intermediate level of variation and the bigmouth shiner, Notropis dorsalis, exhibited the highest level of variation relative to that exhibited by the sand shiner. The interpopulation variation exhibited appeared to be related to the habitat specificity of the species; Notropis dorsalis being restricted to small sandy streams showed the greatest variation, while Notropis deliciosus being the least restricted showed the least variation. Populations from different drainage basins were significantly different from one another in certain characters, but populations from the same drainage basin were also significantly different from each other. This indicates the presence of microgeographic races within a single basin and reduces the significance of interbasin differences. There was no evidence of sexual dimorphism in any of the characters studied, though there was evidence of marked annual variation in certain characters in the bigmouth shiner. These annual differences could not be correlated with climatic differences in the three-year period. The differences found to exist between populations from neighboring streams in the same drainage basin, seemed most easily explained on a genetic basis, rather than by postulating environmental differences where none were apparent. The differences found between populations were interpreted as a reflection of genotypic differences between the various populations. The genetic control of the characters studied has yet to be established. (A)

601. Parsons, John David. 1956. THE EFFECTS OF ACID STRIP MINE POLLUTION ON THE ECOLOGY OF A CENTRAL MISSOURI STREAM. Dissertation Abstracts, Vol. 16, No. 7, pp. 1301-1302.

A study of the effects of acid coal mine pollution on the ecology of a Central Missouri stream was conducted from June 1952 through August 1954. Bottom fauna and plankton populations were sampled monthly from July 1952 through October 1953; water samples for chemical analysis were collected monthly throughout the entire 27-month study period.

Two aspects of pollution were found; the upstream area of the stream was continually polluted and the downstream area was periodically polluted by excessive flows of acid mine water.

To evaluate the effects of an excessive acid flow, the characteristic chemical and physical conditions and biological populations were determined. The degree to which the downstream area was polluted depended upon both the concentrations of effluents and the volume of flow.

The characteristic chemistry of the continually polluted area was apparently little affected by such a flow. The nonpolluted area was affected as follows: (1) the natural bicarbonate buffer system was destroyed, (2) there was a slight lowering in the dissolved oxygen content, and (3) there was an increase in the ions associated with the discharge of acid mine water; namely, aluminum, calcium, magnesium, zinc, lead, sulfate, copper, hydrogen-ion concentration, and titratable acid. However, in final analysis, it appeared that the toxic agent of an excessive acid flow was the acid content of the water, measured as pH and as titratable acid.

The most apparent effect of an excessive acid flow in the nonpolluted area was the precipitation of silt, resulting in clear water of an "apparent" blue color.

Apparently, neither plankton nor benthos populations of the continually polluted area were affected by excessive acid flows. In general, the relatively large populations of this area were not unlike the large populations found in septic zones of organic pollution.

The plankton population of the nonpolluted area was drastically reduced by excessive acid flows. The remaining population was composed entirely of rotifers.

Because the variable occurrence of excessive acid flows into the nonpolluted area coincided with the time of emergence of most benthic species, it was impossible to measure the effects of acid

mine pollution on the benthos. However, there were indications that a shift in the populations had occurred which could be traced to changes in the severity of acid mine effluents.

Fishes were restricted to the nonpolluted area; here, an excessive acid flow with a pH of approximately 4.0 and titratable acidity of approximately 100 p.p.m. was fatal.

A study of the limnology of acid strip mine lakes which contributed to the periodic pollution was conducted from September 1953 through August 1954. Physical data were limited to water temperatures. Titratable acid, sulfate, hydrogen-ion concentration, ferric iron, ferrous iron, copper, zinc, aluminum, calcium, magnesium, lead, and phosphorus were assayed.

Two types of lakes were studied: (1) red lakes, colored by the reddish-black oxides of iron, and (2) blue lakes, colored by reflection in the absence of turbidity. It appears that the reddish-black oxides of iron played a major role in the thermal stratification of red strip mine lakes. The blue lakes lacked turbidity of any type, and they remained homothermous.

Concentrations of sulfate salts increased progressively from surface to bottom; density and viscosity of the water increased accordingly in both types of lakes. (A)

602. Babcock, Philip H. 1956. LEASING VS. FREE FISHING. The Atlantic Salmon J., No. 2, April-May, pp. 7-9.

A partial solution to the question of how European countries have maintained reasonably good salmon fishing for so long, faced as they are and have been with much the same major problems as our own, namely rod pressure and commercial interests, is answered. In Ireland the salmon rivers have been kept as salmon rivers in spite of complex and mechanized modern civilization. That a river can carry just about so many rods and so much netting and no more without seriously impairing the fishing is recognized, and, therefore, a system of leasing fishing privileges has been developed. These privileges are not difficult to obtain and the time duration can be as short as a single day, or extended for years, while the rates in general are quite reasonable, usually less than one-third those charged on a few Canadian rivers employing some such system.

603. Rivas, Luis Rene. 1956. DEFINITIONS AND METHODS OF MEASURING AND COUNTING IN THE BILLFISHES (ISTIOPHORIDAE, XIPHIIDAE). Bull. of Mar. Sci. of the Gulf and Caribbean, Vol. 6, No. 1, March, pp. 18-27.

The need for definition and standardization of methods of measuring and counting in ichthyology is discussed, with special reference to billfishes. A series of measurements and counts for the latter group is proposed and methods and definitions for each are given. The body length is discussed in more detail in connection with its importance as a base length and attention is called to the need for dissection in order to ascertain accurately the number of spines in the first dorsal and first anal fins. (A)

604. Hargis, William J., Jr. 1956. MONOGENETIC TREMATODES OF GULF OF MEXICO FISHES. PART XII. THE FAMILY GASTROCOTYLIDAE PRICE, 1943. Bull. of Mar. Sci. of the Gulf and Caribbean, Vol. 6, No. 1, March, pp. 28-43.

This paper is the twelfth installment of the present series presenting the data concerning monogenetic trematodes collected during the years 1951-1954 at the Alligator Harbor Marine Laboratory of Florida State University. It comprises an emendation of the family Gastrocotylidae Price, 1943 and the subfamily Gastrocotylinae Sproston, 1946 and descriptions and/or discussions of several species.

The new genera Scomberocotyle and Neothoracocotyle have been diagnosed with Scomberocotyle scomberomori (Koratha, 1955) n. comb. and Neothoracocotyle coryphenae (Yamaguti, 1938) n. comb., respectively as their type species. Emendations have been made in Gotocotyla Ishii, 1933, Thoracocotyle MacCallum, 1913, and Lithidocotyle Sproston, 1946. Pseudaxine mexicana Meserve, 1938, Lithidocotyle acanthophallus (MacCallum and MacCallum, 1913) Sproston 1946, Gotocotyla elegatis Meserve, 1938, Neothoracocotyle acanthocybii (Meserve, 1938) n. comb., and Thoracocotyle crocea MacCallum, 1913 have been treated. T. paradoxica has been reduced to synonymy with T. crocea.

In addition several notes concerning host-specificity, zoogeography, speciation and other biological facets have been presented. (A)

605. Rivas, Luis Rene. 1956. THE OCCURRENCE AND TAXONOMIC RELATIONSHIPS OF THE BLUE MARLIN (MAKAIRA AMPLA POEY) IN THE PACIFIC OCEAN. Bull. of Mar. Sci. of the Gulf and Caribbean, Vol. 6, No. 1, March, pp. 59-73.

Evidence is presented indicating that the Atlantic blue marlin also occurs in the Eastern Pacific Ocean. Such evidence includes direct comparison of specimens from both oceans on the basis of quantitative and qualitative characters. The taxonomic relationships of the blue marlin in the eastern Pacific, are established by direct comparison with the black and striped marlins from the same geographical region. In addition, the occurrence of the blue marlin throughout the central and western Pacific is established by discussion of the pertinent literature. (A)

606. Anonymous. 1955. REGIONAL BIBLIOGRAPHY FOR 1954. Bull. of Mar. Sci. of the Gulf and Caribbean, Vol. 5, No. 2, June, pp. 147-159.

The scope of the bibliography is limited in general to the area which includes the southeastern United States, the Gulf of Mexico, and the Caribbean, but papers of more general interest may be listed in cases where they have some special significance to the area.

607. Schäperclaus, W. 1955. AUFSEHENERREGENDE HEILUNGS- UND BEKÄMPFUNGSERFOLGE BEI DER INFEKTIÖSEN BAUCHWASSERSUCHT DER KARPFEN DURCH ANTIBIOTISCHE MITTEL. (Striking results obtained in the treatment and control of infectious dropsy in carp with antibiotics). Deutsche Fischerei Zeitung, Nov., pp. 330-334.

Growth of Pseudomonas punctata, which is the cause of infectious dropsy, was arrested in vitro by the following quantities in micrograms per milliliter of any one of these antibiotics: Chloronitrin (Chloramphenicol) 1.5; Patulin 22.5; Streptomycin 50.0. The activity of the specific bacteriophage was not influenced by any of these drugs. Upon intraperitoneal injection Patulin was most toxic to carp. In spring of 1955 a large number of carp in a population infected with P. punctata were injected with one intraperitoneal dose of the drugs. For carp with the average weight of 270 grams the following quantities of drugs were given: Streptomycin, 100 mg; Patulin, 10 mg; and Chloronitrin, 6 mg. Experiments were carried out in duplicate. At harvest time in the fall, the rates of losses were - controls, 80 percent; Patulin, 100 percent; Streptomycin, 8 percent; and Chloronitrin, 13 percent. The fact that treatment with antibiotics gave such excellent results supports the stand that the infectious dropsy of carp is a bacterial and not a viral disease as suspected by other investigators. (S. F. S.)

608. Schäperclaus, W. 1956. NEUE BEKÄMPFUNGSMABNAHMEN GEGEN DIE INFEKTIÖSE BAUCHWASSERSUCHT DES KARPFENS. (New methods of control of the infectious dropsy in carp). Deutsche Fischerei Zeitung, Aug., pp. 242-248.

Additional results to those published a year ago are described in this paper. Experiments on dosage have shown that even as small amount as 0.2 milligrams of chloramphenicol per carp weighing 300 grams has detectable therapeutic value. However 2-3 milligrams per carp weighing 300 grams is the optimum dose. Feeding food enriched with anti-biotics is not practical for the treatment of a diseased carp population because the uptake of the food by individual fish is not uniform, and sick fish which need the treatment most do not eat. Carp are most susceptible to the outbreaks of infectious dropsy in spring when they have low resistance resulting from debilitating effects of winter. Latent infections usually cause serious outbreaks in spring. Therefore, intraperitoneal treatment with chloramphenicol should be carried out at the time the carp are transferred from winter production ponds. Reduction of mortalities can also be achieved by a 1 hour bath of carp in water containing 80 milligrams of chloramphenicol per liter. This, however, is a more cumbersome and less effective prophylactic treatment of infectious dropsy in carp. (S. F. S.)

609. Wunder, Wilhelm. 1955. DAS VERHALTEN VON HODEN, NIERE UND LEBER NACH ENTFERNUNG VON TEILSTÜCKEN BEIM KARPFEN (CYPRINUS CARPIO L.). (The reaction in carp (Cyprinus carpio L.) of testes, kidney and liver following removal of portions.) Zoologischer Anzeiger, Bd. 155, Heft 9/10, S. 232-239, illus.

Two-year-old carp were anesthetized with urethane, and from 1/4 to 1/2 of testis, kidney or liver was surgically removed. Gut or silk sutures were used to close the incisions, and the fish were returned to ponds. After 6 months they were sacrificed and examined. Regeneration did not occur, but definite compensatory development was noted. Ventral fins on the operated side were retarded in their development. (K. W.)

610. Lieder, Ulrich. 1956. CHROMOSOMENSTUDIEN AN KNOCHENFISCHEN. IV. DIE CHROMOSOMENVERHALTNISSE BEI DER REGENBOGEN- UND BACHFORELLE UND IHREN BASTARDEN. (Chromosome studies of bony fishes. IV. The chromosome complement of rainbow trout, brown trout and their hybrids). Zeitschrift für Fischerei, Band IV, Heft 7/8, S. 589-594, illus.

The author found the diploid (2N) number of rainbow trout to be 60. V-formed chromosomes were most numerous; there were 10 pair of rod-shaped and from 3 to 5 pair of J-shaped. The 2N chromosome number of brown trout is 80. The diploid number for rainbow/brown trout hybrids is 70. This, in the author's opinion, supports Svardson's hypothesis that the Salmonidae exhibit polyploidy. Techniques are given. [Abstractor's note - Wright, Progressive Fish-Culturist, Vol. 17, No. 4, obtained the same chromosome numbers for rainbow and brown trout (2N = 60; 2N = 80), but he found that the brook trout, Salvelinus fontinalis had a diploid chromosome number of 84. This does not support Svardson's theory of Salmonid polyploidy]. (K. W.)

611. Frohne, W. C. 1956. THE PROVENDERING ROLE OF THE LARGER AQUATIC PLANTS. Ecology, Vol. 37, No. 2, April, p. 387.

After removing individual plants of Chara delicatula, Potamogeton gramineus, and Polygonum natans and enumerating macrometazoans qualitatively and quantitatively, Rosine (1955) observed that higher aquatic plants were not significant as food for aquatic insects. The author presents comments on the observations by Rosine and expresses opposing views. In support of these views several publications are cited along with unpublished work of the author and his students carried on in Michigan lakes.

612. Wilson, W. B. and S. M. Ray. 1956. THE OCCURRENCE OF GYMNODINIUM BREVIS IN THE WESTERN GULF OF MEXICO. Ecology, Vol. 37, No. 2, April, p. 388.

Gymnodinium brevis Davis has been associated with mass fish kills in the Gulf of Mexico near the west coast of southern Florida since 1947, but has never been reported from other locations. Although numerous samples were collected throughout large areas of the adjacent Gulf waters during

1948-1950, G. brevis was not observed. In November 1952, a bloom of G. brevis which occurred in an area south and southwest of Sanibel Island was investigated. From September 1953 to January 1955, G. brevis was found consistently in one location or another along the Florida west coast and since January 1955, it has been found sporadically and in low concentrations in that area.

In September 1955, a fish kill near Port Isabel, Texas, was investigated. Twelve samples were collected from an area of the Gulf of approximately 20 square miles between the mouth of the Rio Grande and a point approximately 10 miles north of Port Isabel. All of the samples contained G. brevis. A sample collected near Port Isabel in Laguna Madre did not contain G. brevis. Fish were not dying at the time of our investigation, but dead fish extended along the Gulf beaches from the mouth of the Rio Grande to a point 17 miles north of Port Isabel. On September 15, 1955, fish were observed dying and floating ashore in large quantities along 21 miles of beach from Playa Washington south. A water sample collected at a point 36 miles south of the Rio Grande contained a minimum of 22,000 G. brevis per milliliter. Information from fishermen and airplane pilots indicates at least 120 miles of coast line were affected in the State of Tamaulipas. Fish were still dying on September 27, 1955, along the Tamaulipas coast.

613. Scattergood, Leslie W. 1956. ENGLISH TRANSLATIONS OF FISHERY LITERATURE. (Further listings). U. S. Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 176, July, 32 pp.

This report is a continuation of a series begun by W. M. Chapman during his association with the Washington State Department of Fisheries. The series was initiated to provide fishery investigators with information on the amount and availability of English translations of fishery literature. The first two sections of this series have been issued by the Washington Department of Fisheries, Smith Tower Building, Seattle 4, Washington, and copies may be obtained on request from that agency. The third and fourth reports, undertaken with the cooperation of the above agency, were published by the U. S. Fish and Wildlife Service as Special Scientific Report--Fisheries Nos. 35 and 72, and are available from the Washington office of the Service.

614. Hobbs, Horton H. Jr. 1956. A NEW CRAYFISH OF THE GENUS CAMBARUS FROM NORTH CAROLINA AND SOUTH CAROLINA (DECAPODA, ASTACIDAE). J. of the Elisha Mitchell Sci. Soc., Vol. 72, No. 1, May, pp. 61-67.

In several respects this species seems to be the eastern counterpart of Cambarus striatus Hay (1902:437), which is found in Alabama, Tennessee, and Kentucky. As in this species the narrow areola constitutes 37 to 41 percent of the total length of the carapace. The habits of neither species are adequately known but both have been reported from small streams and burrows. In only one locality has the new species been collected in abundance but evidence of a colony of some size was observed in a poorly drained seepage area at Rockwell in Rowan County, N. C. Here, more than a score of burrows were counted in an area of approximately 800 square feet. A description of new species C. reduncus is presented.

615. Brown. Jerram L. 1955. LOCAL VARIATION AND RELATIONSHIPS OF THE CYPRINODONT FISH, FUNDULUS RATHBUNI JORDAN AND MEEK. J. of the Elisha Mitchell Sci. Soc., Vol. 71, No. 2, Nov., pp. 207-213.

For Fundulus rathbuni, a little known cyprinodont species, found only in the Piedmont region of North Carolina, all known literature references are presented together with a statement of range as far as known from published information and from specimens in the Cornell University fish collection. An unexpectedly large amount of morphological variation among local populations at a level below that of conventional subspecific recognition is demonstrated. It is recommended that the relationships of Fundulus rathbuni to F. stellifer and F. catenatus be recognized by synonymyzing the subgenus Gambusinus under the subgenus Xenisma. (A)

616. Tester, Albert L. 1955. ESTIMATION OF RECRUITMENT AND NATURAL MORTALITY RATE FROM AGE-COMPOSITION AND CATCH DATA IN BRITISH COLUMBIA HERRING POPULATIONS. J. Fish. Res. Bd. Canada, Vol. 12, No. 5, pp. 649-681.

If absolute recruitment (R) and natural mortality rate (q) are both presumed constant in each of two or more periods of stabilized fishing, it is shown that $i = q + (1/R)iC$, where i is instantaneous total mortality rate and C is catch in numbers. The relationship yields approximate estimates of R and q under semi-stable conditions if "average referable C" is related to apparent i, the former derived from catch data and the latter from age-composition data for post-recruited age-groups. In the herring population, in which recruitment takes place mostly at age III but is spread from ages I to IV, the average of the catch of years x and $x+1$ is referable to apparent i at ages IV to V in year $x+2$, at ages V to VI in year $x+3$, etc. When q increases with advancing age, it is shown that R is most accurately estimated from data for ages IV to V; q is slightly overestimated at ages IV to V and underestimated at ages VI to VII and VII to VIII. From data for periods of approximate stability in the lower east coast of Vancouver Island population, average R is estimated at about 500 million fish per year; average q appears to increase with age, ranging from about 0.4 at ages IV to V to about 0.85 at ages VII to VIII. For a recent period of stabilized intensive fishing, a rough estimate of the average initial size of the fishable stock, based on age-composition and catch data, agrees well with that estimated by another method. For populations along the west coast of Vancouver

Island, q also appears to increase with advancing age; R is estimated at about 400 million fish. In an appendix it is shown that a method of estimating q from age-composition and effort data gives unsatisfactory results because effort expended in herring fishing is not proportional to rate of fishing of the stock. (A)

617. Pollard, R. A. 1955. MEASURING SEEPAGE THROUGH SALMON SPAWNING GRAVEL. J. Fish. Res. Bd. Can., Vol. 12, No. 5, pp. 706-741.

The rate of oxygen supply to salmon eggs incubating in a stream bed depends on the oxygen concentration in the groundwater and the rate of seepage through the redd. Wickett (1954) devised a simple field method of both sampling the groundwater for the determination of its dissolved oxygen content and measuring the seepage rate, using one tool, a standpipe. The theory of seepage is outlined to show the factors governing the velocity of flow through a redd. Alternative ways of measuring this velocity were examined; the best one is a modification of Wickett's procedure using a similar standpipe. A new field procedure for measuring the oxygen concentration and groundwater seepage rate in a stream bed is recommended. (A)

618. Smith, S. B. 1955. THE RELATION BETWEEN SCALE DIAMETER AND BODY LENGTH OF KAMLOOPS TROUT, SALMO GAIRDNERI KAMLOOPS. J. Fish. Res. Bd. Canada, Vol. 12, No. 5, pp. 742-753.

The scale/body relationship for Kamloops trout is very close to direct proportion for fish larger than 4.5 cm. fork length. The resultant plot on a double logarithmic grid is linear with a slope not significantly different from 1.00 (45°). Calculations of lengths of trout from scales at ages previous to that of capture can be made on the basis of simple proportion in two ways, (1) by use of a constant slope (45°) on a double logarithmic plot, or (2) by use of a constant zero-zero intercept on an arithmetic plot.

Growth of the scales of the young is characterized by relatively rapid increase from time of scale formation, 3.5 cm. fork length up to 4.5 cm. At about 4.5 cm. fork length there is a sharp break (inflection) in the relative growth curve toward isometric growth of scales and body. Reliable estimates of the length of trout may be obtained from scales alone, using the diameter of the first circulus of the scale, the slopes and inflection of the relative scale/body plot and total diameter of the scale at time of capture.

Marked Kamloops trout of known size were released in 1953. Subsequent recaptures both in 1953 and 1954 substantiated the accuracy of the method of estimating lengths of trout at ages previous to that of capture.

Observations on the steelhead trout, Salmo gairdneri gairdneri, and on the coastal cutthroat trout, Salmo clarki clarki, suggest that an isometric scale/body relationship may exist among those species also. (A)

619. Farris, David A. 1956. DIET-INDUCED DIFFERENCES IN THE WEIGHT-LENGTH RELATIONSHIP OF AQUARIUM FED SARDINES (SARDINOPS CAERULEA). J. Fish. Res. Bd. Canada, Vol. 13, No. 4, pp. 507-513.

In the course of aquarium experiments designed to reveal diet induced changes (if any) in the free amino acid pool of fish muscle, some data were obtained on concurrent changes in the weight-length relationship of the fish on two different diets. The data and interpretation of these weight-length changes are presented here; the results and interpretation of the amino acid analysis will be presented elsewhere. (A)

620. Northcote, T. G. and P. A. Larkin. 1956. INDICES OF PRODUCTIVITY IN BRITISH COLUMBIA LAKES. J. Fish. Res. Bd. Canada, Vol. 13, No. 4, pp. 515-540.

The relation between physical and chemical indices of production and standard crops of plankton, bottom fauna and fish was examined in 100 British Columbia lakes. A significant increase in plankton and fish quantities with increase in total dissolved solid content of the lake waters was demonstrated and a similar relationship suggested for bottom fauna. Although the general form of the relationship between mean depth and plankton, and between bottom fauna and fish quantity, suggested a hyperbolic curve with larger quantities in lakes of low mean depth, the only generalization which seemed justified was that quantities of fauna from lakes of great mean depth were never as high as those found in some lakes of low mean depth. No significant relation was found between intensity and length of growing season and quantities of plankton, bottom fauna or fish, although a significant relationship was demonstrated between summer eiplimnion temperature and plankton.

In a multiple regression analysis using all lakes the predominance of total dissolved solids over mean depth in affecting summed indices of lake fauna was shown. However for lakes in the southern interior plateau, one of the 9 regions distinguished in British Columbia, no significant relation could be demonstrated between mean depth or total dissolved solids and summed indices of fauna or plankton alone. Thus total dissolved solid content of the water appeared to be the most important factor in determining the general level of productivity in lakes studied throughout the province, although within a region neither total dissolved solids nor mean depth could be used either singly or together to predict plankton, bottom fauna or fish quantities. (A)

621. Lapworth, E. D. 1956. THE EFFECT OF FRY PLANTINGS ON WHITEFISH PRODUCTION IN EASTERN LAKE ONTARIO. J. Fish. Res. Bd. Canada, Vol. 13, No. 4, pp. 547-558.

Whitefish fry were planted in the Bay of Quinte and adjacent waters in numbers varying from 208 millions in 1927 to none in 1945. Since 50 percent of the commercial whitefish catch from these

waters consisted of five-year-old fish, whitefish production in each of the years from 1929 to 1951 was compared to the number of fry planted 5 years previously (1924-1946). No correlation could be found between the number of fry planted and the production of whitefish 5 years later. The largest number of fry planted (208 millions in 1927) was followed by the lowest production of the entire period (95 thousand pounds in 1932). On the other hand, following no planting in 1945, production in 1950 was approximately normal (162 thousand pounds).

The age composition of the commercial catch in the years 1944-1951 was determined from scale samples. By applying the age composition to the total catches in these years the contributions of the year-classes 1940-1945 have been estimated. The number of fry planted probably did not affect the contribution of these year-classes to the fishery. (A)

622. Black, Edgar C. 1955. BLOOD LEVELS OF HEMOGLOBIN AND LACTIC ACID IN SOME FRESHWATER FISHES FOLLOWING EXERCISE. J. Fish. Res. Bd. Canada, Vol. 12, No. 6, pp. 917-929.

During the summers of 1953 and 1954 the effects of forced activity on two blood constituents were investigated in seven species of fresh water fishes, representing six families. The fish were hatchery-reared or captured from lakes in the southern Okanagan Valley, and the experiments were carried out in the Summerland Trout Hatchery, Summerland, B. C. Following forced exercise for 15 minutes in water at 11.5° C. the hemoglobin level increased significantly in only one species and the lactic acid increased significantly in all species. There appears to be a correlation between the average value of lactic acid following exercise and the activity of the fish, and also with the position of the species with respect to summer water temperature. (A)

623. Hewson, L. C. 1955. AGE, MATURITY, SPAWNING AND FOOD OF BURBOT, LOTA LOTA, IN LAKE WINNIPEG. J. Fish. Res. Bd. Canada, Vol. 12, No. 6, pp. 930-940.

Burbot are common in Lake Winnipeg; 886 were taken as a sample. Trap-net and otter-trawl catches are more representative of the population than gill-net catches. A significant difference in length-weight relationship exists between two localities. Ages were determined from otoliths. Heavier exploitation in the northern part of the lake probably accelerated the growth rate. Age-6 burbot there weighed 3.4 pounds compared with 2.6 pounds in the southern part. Spawning begins about January 31 and lasts 3 weeks. The smaller burbot feed mainly on insect larvae, the larger burbot on fish and crayfish. (A)

624. Partlo, J. M. 1955. DISTRIBUTION, AGE AND GROWTH OF EASTERN PACIFIC ALBACORE (THUNNUS ALALUNGA GMELIN). J. Fish. Res. Bd. Canada, Vol. 12, No. 1, pp. 35-60.

Seasonal and regional variations in the abundance of albacore during the 1949, 1950 and 1951 British Columbia fishing seasons suggest that exploitable stocks occurred in increasingly northerly areas during July and August and in more southerly areas during late August, September and early October. Catches were composed of four length-groups with average lengths of 54.3, 62.9, 71.7 and 81.9 centimeters. These groups were sometimes fairly discrete, but usually overlapped broadly, so that it was necessary to plot frequency distributions on probability paper in order to choose the best points of separation.

Concentric marks on the centra of vertebrae were used as indicators of the age of the fish. The relationship of body length to vertebral radius is rectilinear. There is good agreement between the estimated average length and standard deviation in length of the fish when grouped by length and when grouped by vertebral ring number. The ages indicated for the four groups are III, IV, V and VI; however the first vertebral ring is somewhat less clear than the others and if it were discounted these ages would be reduced by one year. The fish whose vertebrae were examined had almost completed a year's growth.

The length-weight relationship is expressed by the formula, $\log W = -4.912 + 3.13 \log L$, where W is the weight in kilograms and L is the fork length in centimetres. (A)

625. Forrester, C. R. and K. S. Ketchen. 1955. THE RESISTANCE TO SALT WATER CORROSION OF VARIOUS TYPES OF METAL WIRE USED IN THE TAGGING OF FLATFISH. J. Fish. Res. Bd. Canada, Vol. 12, No. 1, pp. 134-142.

Observations on the metal used as pins for Petersen-type tags on Parophrys vetulus showed manufactured nickel pins to be most subject to corrosion or wear, with pins of silver wire, nickel and stainless steel wire successively less liable. Tagging wounds were worst with nickel pins and least with stainless steel wire. A correction factor of approximately 1.7 for each year the tag is out is necessary to bring results with nickel pins on a par with those of stainless steel wire. (A)

626. Fraser, J. M. 1955. THE SMALLMOUTH BASS FISHERY OF SOUTH BAY, LAKE HURON. J. Fish. Res. Bd. Canada, Vol. 12, No. 1, pp. 147-177.

The smallmouth bass (Micropterus dolomieu) population of South Bay, Lake Huron and the sport fishery imposed on it have been studied by means of marking and creel census carried out during the years 1947 to 1952 inclusive. Population estimates of legal-sized bass (over 10 inches – fork length), based on the recovery of marked fish, show a decrease from 5,900 fish in 1947 to 2,900 in 1949 with an increase again to 5,700 in 1952. The number of bass caught per 100 rod-hours in these years was 89, 51 and 87, respectively.

The recovery of the population from its low in 1949 was due solely to the 1947 year-class which dominated the fishery in 1950, 1951 and 1952 contributing 34, 71 and 67 percent, respectively, of the anglers' catch in these years. Analysis of scale samples of the anglers' catch shows considerable variation in year-class strength. In contrast to the 3,500 fish contributed to the anglers' creel by the 1947 year-class, the 1945 year-class contributed only 400 fish.

South Bay bass enter the sport fishery in small numbers at age III and 70 percent of the anglers' catch consisted of age-III to age-V fish. Sixty percent of the legal-sized population of bass present in South Bay in one year are taken by anglers in the succeeding 4-5 years at the present exploitation.

A large percentage of the bass population is located in the Inner Basin of South Bay where they are dispersed in varying concentrations along the shoreline. During the five-year study 3,331 bass were tagged and, although the loss of tags was high, 692 were recaptured by trap nets in the same season they were released. Eighty-five per cent of these were taken within two miles of their release point. Of 60 bass recaptured a year after tagging, 43 (72 percent) were taken within two miles of their release point. Only five percent of all recorded recaptures were caught over five miles from their release point. Larger bass tended to range farther than small bass. (A)

627. Hoar, William S. 1955. PHOTOTACTIC AND PIGMENTARY RESPONSES OF SOCKEYE SALMON SMOLTS FOLLOWING INJURY TO THE PINEAL ORGAN. J. Fish. Res. Bd. Canada, Vol. 12, No. 1, pp. 178-185.

The experiments show clearly that the pineal region of the sockeye salmon smolt is sensitive to light and that receptors here play a part both in the control of chromatophores and in the negative phototaxis which is so marked in juvenile sockeye. The amount of light reaching the pineal organ is apparently controlled by the distribution of pigment in a patch of chromatophores above this area of the brain. Breder and Rasquin (1950) report that fish capable of such control often show what appears to be an erratic behaviour in regard to their reactions to light. The variable responses to light shown by sockeye at different times in their life history and in different experimental situations is perhaps, then, to be expected.

Sockeye fry used in this study had recently hatched from the gravel of a stream and were descending into Lakelse Lake. The smolt, on the other hand, had spent one year or longer in the lake and were descending the outlet river toward the ocean. These migrations occur at low light intensity and the photosensitivity of this area of the brain may in some way be involved in the activities. Differences in degree of negative phototaxis of fry and smolt may be correlated with differences in the degree of pineal development. At the moment, however, there is no evidence for this speculation and it can only be concluded that the pineal region of the brain of the sockeye smolt is photosensitive and plays an active part in chromatophore control and in the negative phototaxis characteristic of the sockeye smolt. (A)

628. Hoar, William S. 1956. THE BEHAVIOUR OF MIGRATING PINK AND CHUM SALMON FRY. J. Fish. Res. Bd. Canada, Vol. 13, No. 3, pp. 309-325.

Pink salmon fry which have never schooled are negatively phototactic, prefer a cover of stones and do not emerge into bright light. Those which have schooled show a strong cover reaction when exposed to a rapid increase in light intensity but do not seek cover unless the change is abrupt. In general they remain in bright light after they have schooled. This change in behaviour occurs rapidly (15 minutes or less) when the fry school for the first time. Chum salmon fry establish a definite direction of swimming in the quiet water of a circular channel or basin. The established direction is stable and not permanently disturbed by light or darkness, by water currents, by strong avoiding reactions, by changing the location or by excluding direct skylight. The direction may be initially established in relation to water currents. (A)

629. Larkin, P. A. 1956. INTERSPECIFIC COMPETITION AND POPULATION CONTROL IN FRESHWATER FISH. J. Fish. Res. Bd. Canada, Vol. 13, No. 3, pp. 327-342.

Interspecific competition is defined as the demand of more than one organism for the same resource of the environment in excess of immediate supply. When two species are "competing for a niche" the term competition has been used to include phenomena such as predation of the two species on each other, competition to avoid a parasite, etc. Making this distinction in natural situations is unrealistic. In the limited sense in which interspecific competition is defined above, it is a discrete phenomenon, which with other phenomena such as predation, can be measured as a factor involved in interaction between species.

Freshwater environments offer comparatively few opportunities for specialization in fishes. In consequence many species have a relatively wide tolerance of habitat type, a flexibility of feeding habits and in general share many resources of their environment with several other species of fish. Cannibalism and mutual predation are common complications of competitive relationships between species. The organization of freshwater fish communities is thus characterized by breadth at each level of the food chain rather than by a height of a pyramid of numbers. Flexible growth rate and high reproductive potential permit fish populations to tide over unfavorable periods of competition. In these circumstances it is difficult to separate the role of interspecific competition from other phenomena as a factor of population control. As a subordinate factor, predisposing fish to loss from other causes, interspecific

competition may act to influence population levels. There is need for quantitative data and mathematical models for study of the types of population interaction typical in freshwater fish associations. (A)

630. Ketchen, K. S. 1956. CLIMATIC TRENDS AND FLUCTUATIONS IN YIELD OF MARINE FISHERIES OF THE NORTHEAST PACIFIC. J. Fish. Res. Bd. Canada, Vol. 13, No. 3, pp. 357-374.

Mean annual air temperature at San Francisco, California, New Westminster and Masset, British Columbia, all had a rising trend from 1920 to 1940, then declined to 1950. Amplitude was greatest at Masset, least at San Francisco. The 20-years' rise is similar to the story in the North Atlantic ocean, but the recent decline has no parallel there. Prior to 1920 there were considerable differences among the above three stations. Mean annual ocean temperature at Nanaimo, B. C., is similar to air temperature at New Westminster since 1915. "Winter" ocean temperatures (February-April) show similar but not identical trends, and are thought to best represent conditions at the time eggs and larvae of most commercial bottom fishes are in the water.

Suggestive short-term correlations have been observed as follows: 1. a positive correlation between winter temperature and abundance of brill 6 years later; 2. a negative correlation between winter temperature and rock sole abundance 5 years later; 3. a negative correlation between winter temperature and strength of year-classes in lemon sole. Over a longer period, there is much resemblance between the temperature history since 1910 and the abundance of halibut broods, as indicated by catch per unit effort 10 years later (southern grounds) or 12 years later (western grounds). The relationship is positive, and for western grounds is similar even in details. Over a somewhat shorter period, blackcod abundance has varied inversely with winter temperature. Marked changes in abundance and distribution of true (grey) cod since about 1900 cannot be related to temperature series available. (A)

631. Kleerekoper, H. and Kira Sibakin. 1956. AN INVESTIGATION OF THE ELECTRICAL "SPIKE" POTENTIALS PRODUCED BY THE SEA LAMPREY (PETROMYZON MARINUS) IN THE WATER SURROUNDING THE HEAD REGION. J. Fish. Res. Bd. Canada, Vol. 13, No. 3, pp. 375-383.

In the water surrounding the head of Petromyzon marinus electric triphasic spike potentials can be recorded which recur rhythmically at 0.4-second intervals and are synchronous with the externally visible movement of respiration. At a distance of 15 to 20 mm. from the animal, above the eye region, the potentials are from 200-300 μv in an adult lamprey, in fresh water. The electric field produced by these potentials extends several centimeters frontwards of the head depending on experimental conditions and factors now being studied. Posterior to the gill openings the potentials taper off sharply and no spikes could be recorded 50-70 mm. posterior to the last gill opening. The field is symmetrical around the longitudinal axis of the animal under the experimental conditions described. Strychnine and cocaine do not affect the production of the spikes. The possible function of the electric field for the sea lamprey is discussed. (A)

632. Blair, A. A. 1956. ATLANTIC SALMON TAGGED IN EAST COAST NEWFOUNDLAND WATERS AT BONAVISTA. J. Fish. Res. Bd. Canada, Vol. 13, No. 2, pp. 219-323.

In 1940, from June 8 to June 28, 68 salmon and 386 grilse were tagged at Bonavista on the east coast of Newfoundland. The fish used were caught by commercial fishermen in salmon traps set along the coast within 3 1/4 miles of the lighthouse at Bonavista.

The proportion of tagged salmon recaptured during the year of tagging was 41.2 percent, and 1.5 percent in the following year. The 28 tagged salmon recaptured in 1940 were distributed as follows: Newfoundland 57.1 percent, mainland of Canada 39.3 percent, and Labrador 3.6 percent. The greatest distance travelled was 785 miles, and the fastest apparent rate of travel was 26.2 miles per day.

The tagged grilse returns were 36.3 percent in 1940 (year of tagging), 2.6 percent in 1941, and 0.3 percent in 1942. The 140 tagged grilse recaptured in 1940 were distributed as follows: Newfoundland 92.9 percent, and mainland 7.1 percent. The greatest distance travelled by recaptured grilse was 792 miles, and the fastest apparent rate of travel was 32.5 miles per day, both exceeding the highest values for salmon. The average interval between tagging and recapture (during the same year) for the grilse taken commercially on the east coast of Newfoundland was 14.3 days, on the south coast 20.2 days, and on the mainland 28.8 days. (A)

633. Rawson, D. S. 1956. THE NET PLANKTON OF GREAT SLAVE LAKE. J. Fish. Res. Bd. Canada, Vol. 13, No. 1, pp. 53-127.

The net plankton of Great Slave Lake was studied extensively in the years 1944 to 1947 and sampling continued at a central station through 1954. Some 490 samples were taken using large nets and traps with No. 20 silk. Taxonomic, gravimetric and numerical analyses are reported and comparisons made between the larger, open lake and the deep, cold, east arm.

Among 160 species of algae, two diatoms, Melosira islandica and Asterionella formosa were dominant. Green and blue-green algae were scanty but Dinobryon was numerous, especially in the cold, east arm. Among 26 rotifers Keratella cochlearis and Kellicottia longispina were dominant and four other species common. Cladocera were scarce but the copepods made up about 85 percent of the plankton volume. Diaptomus spp., Cyclops spp., Limnocalanus macrurus, Epischura lacustris and Senecella calanoides were the main

species.

The average dry weight of the standing crop of net plankton in the open water was 21.8 kg./ha. The crop was heavier in years of warm water than in those of colder water. Occasional high turbidity was associated with decreased plankton. In Christie and McLeod Bays of the east arm, where the waters are deeper, colder and lower in mineral content, the average dry weight of plankton was 14.3 and 9.0 kg./ha. These amounts are typical of the plankton in large, very oligotrophic lakes.

An early season maximum of diatoms and copepods was followed by a rapid decline in late July. The smaller, late-summer maximum included large numbers of rotifers. More than half of the plankton was in the upper 25 metres with decreasing amounts down to 100 meters. A thin plankton mainly of copepods, extends down to 600 meters.

The dominant species of plankters in the open water of Great Slave Lake appear to be almost identical with those of Lake Winnipeg, Lake Nipigon and the Great Lakes. All have a diatom-copepod type of plankton with a constant group of rotifers and Dinobryon in moderate numbers. Green and blue-green algae are scanty except in the shallower and warmer lakes, Winnipeg and Erie. (A)

634. Van Oosten, John and Paul H. Eschmeyer. 1956. BIOLOGY OF YOUNG LAKE TROUT (SALVELINUS NAMAYCUSH) IN LAKE MICHIGAN. Fish and Wildlife Service Res. Rep. 42, 88 pgs.

Experimental fishing with gill nets of 5 mesh sizes (2 3/8 to 3 inches) in Lake Michigan in 1930-32 yielded more than 16,000 young lake trout. Data are presented here on age, growth, length-weight relationship, abundance, geographical and bathymetric distribution, and other details of their biology.

Four-year-old fish predominated in the collections. Time of resumption of seasonal growth and length of the growing season varied widely among individuals, and in different calendar years, age groups, and localities. Average annual increments in length varied from 3.4 to 4.6 inches in the first 3 years of life but were less during later years.

In lower Lake Michigan the average total length and weight of lake trout caught ranged progressively from 12.4 inches and 8.8 ounces in the 2 3/8-inch mesh to 15.2 inches and 17.8 ounces in the 3-inch mesh. Average numbers of lake trout caught per net were nearly identical in the 2 1/2-, 2 5/8-, and 2 3/4-inch meshes, but were somewhat smaller in the 2 3/8- and 3-inch meshes (a relationship explained in part by the predominance of the IV-group among young trout in the lake). The average total weight of trout caught per net increased progressively with each increase in mesh size.

Young lake trout were widely distributed in Lake Michigan and were taken at nearly all stations and at all depths fished. They were most abundant along the east shore of the lake, less plentiful in the northern region, and least numerous along the west shore. Highest concentrations of trout were at depths of 40-49 fathoms in the lower lake and at 30-39 fathoms in the northern region. Appreciable seasonal shifts in bathymetric distribution were not observed. (A)

635. Perlmutter, Alfred, William S. Miller and John C. Poole. 1956. THE WEAKFISH (CYNOSCION REGALIS) IN NEW YORK WATERS. N. Y. Fish and Game J., Vol. 3, No. 1, Jan., pp. 1-43.

A reported scarcity of weakfish in New York waters led to the initiation of a study of this species by the New York State Conservation Department in 1952. Based on data collected both by Nesbit in the early 1930's and by the present investigators, it was found that the resource of weakfish available to New York fishermen consists of both locally spawned and southern-spawned fish. Weakfish are abundant in New York waters only when the southern-spawned stock is large. In recent years this stock has been smaller than ever before in the history of the fishery, and the New York fishery has depended mostly on locally spawned fish. For New York to enjoy once more the abundant weakfish supply of the 1920's would necessitate an increase in the stock of southern-spawned fish. The feasibility of increasing this stock can only be determined through cooperative study by the conservation agencies of those states whose waters contribute, in important measure, to the weakfish resource. (A)

636. Burdick, G. E., Howard J. Dean and Earl J. Harris. 1956. TOXICITY OF EMULSIFIABLE ROTENONE TO YELLOW PERCH. N. Y. Fish and Game J., Vol. 3, No. 1, Jan., pp. 75-80.

The toxicity of rotenone to yellow perch was studied under controlled laboratory conditions and a toxicity curve constructed. The effect of length on time for death was calculated and was found to be not significant. The means for time for death in the five concentrations used are plotted, as is the curve representing the equation for the regression of those means which tend to fall on a straight line. This is superimposed upon a graph depicting the comparative toxicity of rotenone to brown trout, rock bass, creek chub, smallmouth bass, common sucker and brown bullhead as determined by the authors. (A)

637. Haskell, David C. and Robert Griffiths. 1956. GROWTH IN RELATION TO SEX AMONG BROOK TROUT. N. Y. Fish and Game J., Vol. 3, No. 1, January, pp. 93-107.

Unsorted samples of brook trout fingerlings had an approximately 50:50 sex ratio. Bar sorters, as used in hatcheries to grade trout into nearly even-sized groups, were shown to produce unbalanced sex ratios among the sorted groups, the larger fish being predominantly males. The effect seems too small to be of much importance unless only a few of the largest fish are sorted out, in which case there will be a very high proportion of males.

Length and weight data according to sex for a small group of brook trout were taken over a period of a year and a half. The rate of growth, as measured by increases in length or in the cube root of the weight, was found to be slightly higher for males than for females. It was nearly the same for the groups produced by sorting when allowance was made for differences in the sex ratio. Although the average growth rate was approximately the same for groups of different size, great variation was observed among individual fish, so that the effect of sorting was only temporary in producing groups of uniform size. Selection of the largest fish by length or weight at a given age was found to have little value in predicting their subsequen growth rate. (A)

638. Haskell, David C., Louis E. Wolf and Loyal Bouchard. 1956. THE EFFECT OF TEMPERATURE ON THE GROWTH OF BROOK TROUT. N. Y. Fish and Game J., Vol. 3, No. 1, Jan., pp. 108-113.

Growth data were collected on 16 lots of brook trout from a single original source. Two lots were assigned to each of eight hatcheries and reared under controlled conditions from a size of 1 1/2 inches to one of 4 3/4 inches. The difference between hatcheries and the effect of temperature on growth rate were calculated from the data. It is shown that at a given temperature approximately the same number of days was required for each one-half inch of growth. (A)

639. Crawford, Ronald W. 1956. A STUDY OF THE DISTRIBUTION AND TAXONOMY OF THE PERCID FISH PERCINA NIGROFASCIATA (AGASSIZ). Tulane Studies in Zoology, Vol. 4, No. 1, Aug. 1, 55 pgs.

Percina nigrofasciata is distributed widely in the southeastern United States. Its range is bounded to the west by the Mississippi River and to the east by the Edisto River. P. nigrofasciata extends soutward into peninsular Florida by way of the Suwannee and St. Johns River systems. It extends northward as far as the headwaters of the Chattahoochee and Savannah River systems in Georgia and South Carolina.

Two subspecies of P. nigrofasciata are recognized: P. n. nigrofasciata, which has usually been referred to as Hadropterus nigrofasciatus, and P. n. raneyi, a new subspecies. The latter has more body scales than the former and also differs in several body proportions. Populations of intergrades between the two subspecies are present in three river systems. Eight races of P. n. nigrofasciata are designated.

P. n. nigrofasciata apparently originated on the coastal plain near the mouth of the Mississippi River. Dispersal proceeded eastward through connecting swampy areas during periods of high water. Dispersal northward may have been forced and rapid due to one of the submergences of the coastal plain during the Pleistocene, or it may have been gradual.

P. n. raneyi originated above the fall line in the Savannah River system. Its immediate ancestors probably made their way over this barrier in one of two ways: by gradually ascending the barrier into water above the falls, or through stream capture of the Chattahoochee River by the Savannah River, allowing fishes from the former system to enter the new habitat of the upper Savannah River. The writer favors the latter explanation, as it explains the isolating mechanism necessary for differentiation to occur. (A)

640. DeSylva, Donald P. 1955. THE OSTEOLOGY AND PHYLOGENETIC RELATIONSHIPS OF THE BLACKFIN TUNA, THUNNUS ATLANTICUS (LESSON). Bull. of Mar. Sci. of the Gulf and Caribbean, Vol. 5, No. 1, March, pp. 1-41.

Comparisons with five other species of the genus Thunnus were made to determine the relationships and phylogenetic position of T. atlanticus and its correct taxonomic identity. From osteological evidence, T. atlanticus is intermediate with T. sibi and T. albacares and is slightly closer to the latter. The splitting of the genus Thunnus as proposed in the past by various authors is osteologically unsubstantiated in view of the compactness of the group formed by the six species of Thunnus and their closer relationships to each other than to any of the neighboring genera (Katsuwonus, Euthynnus, Sarda) with which Thunnus was compared. It is therefore suggested that the names Parathunnus, Neothunnus and Germo be incorporated with the genus Thunnus. (A)

641. Maher, F. P. and P. A. Larkin. 1955. LIFE HISTORY OF THE STEELHEAD TROUT OF THE CHILLIWACK RIVER, BRITISH COLUMBIA. Trans. the Amer. Fish. Soc., 1954. pp. 27-38.

Nearly 800 scale samples submitted by anglers were used to investigate features of the life history of steelhead trout (Salmo gairdneri gairdneri) from the Chilliwack River, a tributary of the Fraser River near Vancouver, British Columbia. After criteria for scale reading were established, data on age, fork length, sex, month and year of capture, previous spawning history and lengths at previous ages were treated statistically. Age groups are so designated as to indicate the amount of time spent in the river and in the ocean; thus 2/3 refers to fish that were 2 years in the stream and 3 in the ocean. Age composition of adult runs of steelhead trout tended to be uniform from year to year. The four major types of life history were: fish spending 2 or 3 years in fresh water and 2 or 3 years in salt water. No correlation existed between the numbers of years spent in fresh water and in salt water. Length at maturity was determined by the number of years in salt water. There was no tendency for fish of any particular age, length, or sex to return to fresh water at any particular time of year. Sixty percent of young steelhead trout migrate to salt water in the spring months as age 2 at an average length of 16.49 centimeters. Thirty-five percent go seaward as age 3 at an average length of 19.95

centimeters. A few smolts remain in fresh water until late summer. These and other findings are related to management of steelhead trout for sport fishing. (A)

642. Thompson, William H. 1955. PROBLEMS OF RESERVOIR MANAGEMENT. Trans. Amer. Fish Soc., 1954. pp. 39-46.

The reservoir construction program during the last few years in Oklahoma has effected a tremendous increase in fishing opportunities. The answers to many fishery management problems arising out of the reservoir construction have been answered through cooperative endeavor of Federal agencies, state agencies, and schools of higher learning. Artificial reservoirs are so prolific in fish production that overpopulation is the main problem. Much more efficient commercial fish and sport fish harvest programs are needed, however, public resistance is at present the principal impediment to better management. (A)

643. Eschmeyer, Paul H. 1955. THE REPRODUCTION OF LAKE TROUT IN SOUTHERN LAKE SUPERIOR. Trans. the Amer. Fish. Soc., 1954. pp. 47-74.

The principal spawning grounds of lake trout (Salvelinus namaycush namaycush) in United States waters of southern Lake Superior are on rocky shoals at depths of less than 20 fathoms. Most spawning occurs in October and early November. Of the mature fish collected on or near the spawning grounds, 60 to 69 percent were males. Among mature fish the average length of females was greater than that of males; few males less than 24 inches or females less than 26 inches in total length were caught. Recoveries of lake trout tagged on the spawning grounds showed that some males remained in the immediate area for a period of several weeks during the spawning season. Marked fish showed a tendency to return during later years to spawning grounds on which they had been tagged, even though many of them ranged long distances between spawning seasons.

The percentage of the total weight composed by gonads of maturing females collected in 1950 was 5.0 percent on August 11-30 and 12.3 percent on October 6-9, but this increase was not accompanied by an increase in the coefficient of condition.

One volumetric and two gravimetric methods for estimating numbers of eggs in ovaries were evaluated. Some advantage in accuracy of estimate resulted from the drying of eggs in an oven before weighing on an analytical balance. Production of eggs by 70 lake trout ranging from 25.1 to 38.0 inches in total length and from 5.8 to 19.6 pounds in weight ranged from 2,476 to 17,119. Average production was 646 per pound of fish; this number was greater among fish 31.0 inches long or larger than for fish of smaller size.

Thirteen fish identified by commercial fishermen as siscowets (Salvelinus namaycush siscowet) also showed extensive individual variation in numbers of eggs, although egg production tended to increase with increasing length and weight of the fish. A mature female siscowet as small as 16.5 inches long and a 15.7-inch mature male were collected about 45 miles north of Grand Marais, Michigan. Combined data from all collections showed that spawning of lake trout or siscowets may occur during at least 6 months of the year (June to November). (A)

644. Rupp, Robert S. 1955. BEAVER-TROUT RELATIONSHIP IN THE HEADWATERS OF SUNKHAZE STREAM, MAINE. Trans. the Amer. Fish Soc., 1954. pp. 75-85.

The effect of beaver, Castor canadensis (Kuhl), on an eastern brook trout, Salvelinus fontinalis (Mitchill), population was studied in the vicinity of five beaver dams in the headwaters of Sunkhaze Stream. The beaver dams were found to present a serious obstacle to trout movements but they were not a complete barrier. Estimated unit-area production of bottom organisms was poor in the beaver ponds but the beaver had so increased the bottom area that total production of the stream section was probably more than doubled. Forage fishes appeared to be somewhat more abundant in the beaver ponds than in the open stream and constituted an unexpectedly high percentage of the food of 6- to 10-inch brook trout taken in the ponds. Measurable but not serious water-quality reduction was found in and below the beaver ponds. (A)

645. Snieszko, S. F. and E. M. Wood. 1955. THE EFFECT OF SOME SULFONAMIDES ON THE GROWTH OF BROOK TROUT, BROWN TROUT, AND RAINBOW TROUT. Trans. the Amer. Fish. Soc., 1954. pp. 86-92.

Sulfonamides such as sulfisoxazole (Gantrisin), sulfamerazine, and a mixture of sulfamerazine with sulfaguanidine were fed to apparently normal fingerlings of brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), and rainbow trout (Salmo gairdneri). None of these drugs had any growth-affecting influence on rainbow trout. Growth of brook trout was somewhat retarded by sulfamerazine. The retardation of the growth of brown trout was greater with sulfamerazine than with the mixture of two sulfonamides. Sulfisoxazole did not retard growth of any of the three species. As soon as the medicated food was replaced with normal, brown trout resumed growth. Observations are also furnished on the tissue levels of sulfonamides and hemoglobin in the experimental trout. (A)

646. Pratt, Virgil S. 1955. FISH MORTALITY CAUSED BY ELECTRICAL SHOCKERS. Trans. the Amer. Fish. Soc., pp. 93-96.

Under experimental conditions legal-sized brook trout, brown trout, and rainbow trout exposed to 110-volt alternating- and 230-volt direct-current electricity suffered an average mortality of 6.4 percent. Immediate mortality amounted to 4.3 percent and the delayed type accounted for 2.1 percent of the deaths. Of the

trout exposed to alternating current 11.1 percent died whereas only 2.0 percent of those treated with direct current were killed. There appeared to be no relationship between mortality and either fish size or trout species. Both types of units are considered to be acceptable for stream population studies. (A)

647. Clemens, Howard P. and Woodrow H. Jones. 1955. TOXICITY OF BRINE WATER FROM OIL WELLS. Trans. the Amer. Fish. Soc., 1954. pp. 97-109.

Studies of the median toxicity thresholds for 10 species of fish in brine wastes from a single oil well showed a range of the thresholds from 4.3 to 11.2 percent of the original brine by volume. A similar study on 10 kinds of invertebrates revealed a range of thresholds from 1.8 to 8.7 percent. Thresholds were expressed as percentage volume of the original waste since the brine contained large amounts of calcium, magnesium, potassium, and sodium as well as chloride ions. However, computations of hypothetical combinations of chlorides in the brine indicated sodium chloride to be present in such proportions as to be most toxic.

Median toxicity thresholds were determined also for six species of fish and five kinds of invertebrates in tap water and sodium chloride. A comparison of these thresholds with those in brine wastes, expressed as p.p.m. hypothetical sodium chloride, revealed that three species of fish (plains killifish, gambusia, and the black bullhead) could withstand more sodium chloride in brine wastes than in a solution of sodium chloride alone, whereas the reverse was true for the other three species (green sunfish, red shiner, and the fathead minnow). The thresholds were similar, however; those of brine fell within the fiducial limits of the thresholds in sodium chloride. Four of five kinds of invertebrates withstood slightly less sodium chloride (hypothetical) in brine than in a solution of sodium chloride alone. A somewhat better agreement between the thresholds in brine and in sodium chloride was obtained if the thresholds were expressed as p.p.m. chloride and p.p.m. sodium ions. In the two solutions, the threshold concentrations were much closer for sodium than for chlorides for the plains killifish, gambusia, and bullheads. For the green sunfish, red shiner, and fathead minnow, however, the threshold values in brine and in sodium chloride were much closer expressed as p.p.m. chloride than as p.p.m. sodium.

A comparison of the chloride-ion tolerance of three species of fish and three kinds of invertebrates in laboratory experiments and from field observations indicated similar tolerance for all forms in the two situations.

Preliminary studies on the acclimation of plains killifish to sodium chloride indicated that this species could withstand 8,649 p.p.m. more sodium chloride when it had been living in waters containing 6,329 p.p.m. chloride than when it had been in waters containing less than 100 p.p.m. chloride. Differences of temperatures did not affect the median toxicity threshold appreciably, but the mortality rate increased with the temperature.

Future studies on these wastes should include work on the antagonistic effects of calcium, magnesium, sodium, and potassium in the presence of the chloride ion.

The presence of calcium, magnesium, sodium, and potassium ions in brine wastes in high concentrations along with chloride ions creates important questions. (A)

648. Larimore, R. Weldon. 1955. MINNOW PRODUCTIVITY IN A SMALL ILLINOIS STREAM. Trans. the Amer. Fish. Soc., 1954. pp. 110-116.

As a means of evaluating the effects of harvesting minnows in a small stream, a study was made of the minnow population in a section of Jordan Creek in east-central Illinois. Nine collections of minnows were made with an electric fish shocker from August 1950 through October 1953. These collections represented a large proportion of the existing population. The yields for the corresponding months of each of the succeeding years increased progressively. The minnow population as a whole exhibited annual cycles of abundance and of average weights of individual fish. Each species responded differently to various environmental factors and to the continuous cropping. Shocking, which is a more effective method of harvesting minnows than is seining, did not reduce the minnow population in the study section of Jordan Creek longer than a few months. The natural fluctuations of the minnow population made it difficult to measure the effects of cropping with the electric shocker. (A)

649. Lewis, William M. and Charles Peters. 1955. PHYSICO-CHEMICAL CHARACTERISTICS OF PONDS IN THE PYATT, DESOTO, AND ELKVILLE STRIP MINED AREAS OF SOUTHERN ILLINOIS. Trans. the Amer. Fish. Soc., 1954. pp. 117-124.

The physico-chemical characteristics of ponds of three strip-mine areas in Southern Illinois were observed under both winter and summer conditions. In addition to a general discussion of the areas, a detailed report is made on dissolved oxygen as associated with thermal stratification, and on pH and specific conductance. Observations were also made on the plant life and fishes of the ponds. The more important findings included high concentrations of dissolved oxygen in the thermocline, pH values ranging from 3 to 8, and extremely high specific conductance. Chemical conditions were not associated with the age of the ponds. The ponds have many characteristics of oligotrophic lakes and the possibilites for fish production are limited. The most common fishes of the ponds were the green sunfish (Lepomis cyanellus), bluegill (Lepomis macrochirus), and largemouth bass (Micropterus salmoides). Some ponds were devoid of fish life. (A)

650. Crowe, Walter R. 1955. NUMERICAL ABUNDANCE AND USE OF A SPAWNING RUN OF WALL-

EYES IN THE MUSKEGON RIVER, MICHIGAN. Trans. the Amer. Fish. Soc., 1954. pp. 125-136.

During March and April of 1953 and 1954 Walleyes were tagged and released in Muskegon Lake before they ascended the Muskegon River on a spawning migration. Recoveries of the tagged walleyes were made by dip nets below Newaygo Dam 39 miles upstream. Estimates of the numerical abundance of the spawning runs computed from these recaptures (ratio of tagged to untagged walleyes in the dip-net catch) were about 114,000 individuals in 1953 and about 139,000 fish in 1954.

From the population estimates it was determined that transfer of between 7,000 and 8,000 walleyes to reservoirs above Newaygo Dam did not involve a large percentage of the total run. Of the walleyes that were not transferred, about 9,000 to 11,000 were captured by anglers; the cropping rate, therefore, was small. (A)

651. Wales, J. H. and Millard Coots. 1955. EFFICIENCY OF CHINOOK SALMON SPAWNING IN FALL CREEK, CALIFORNIA. Trans. Amer. Fish. Soc., 1954. pp. 137-149.

The spawning efficiency of chinook salmon (Oncorhynchus tshawytscha) in Fall Creek, a tributary of the Klamath River in northern California, was measured during four runs, 1950-1954, inclusive. In these years the following numbers of pairs of spawners were allowed to enter the stream: 750, 500, 300, and 300, respectively. Estimates of the total egg production of these fish were based on sampling. The numbers of downstream migrant fingerlings resulting from each of these spawning runs were computed by trapping the migrants in a known fraction of the stream flow. The percentages of potential eggs resulting in migrants leaving Fall Creek in the years sampled were 7, 10, 9, and 32, respectively. There appears to be an inverse correlation between the size of floods during incubation and the efficiency of spawning. (A)

652. Wilber, Charles G. 1955. LIPIDS IN THE NORTHERN PIKE. Trans. Amer. Fish. Soc., 1954. pp. 150-154.

The northern pike, Esox lucius, is a ready source of food in many arctic and subarctic areas of North America. Because little information is available concerning lipids in fresh water fish a study was made of these substances in the northern pike. Specimens were caught on hooks in Lake Minchumina, Alaska. Blood and liver were analyzed for fatty acids, sterols, and phospholipids. The pike is distinctive in having a rather high liver cholesterol—0.89 percent of fresh tissue. The other lipids are not unique but fall into the pattern for animals previously studied. However, marine fish in general have consistently more fat in the liver than does the northern pike. (A)

653. Wood, E. M., W. T. Yasutake and S. F. Snieszko. 1955. SULFONAMIDE TOXICITY IN BROOK TROUT. Trans. Amer. Fish. Soc., 1954. pp. 155-160.

Sterility was observed in female brook trout that were treated with sulfamerazine at frequent intervals for 2 years to control endemic furunculosis. Feeding sulfamerazine for a period of 8 months caused massive kidney damage similar to that observed in humans who develop allergies to "sulfa" drugs. Kidney damage of the type observed would probably cause renal insufficiency which would handicap any physiological function including reproduction. Feeding sulfonamides for periods up to 13 weeks did not produce kidney damage. (A)

654. Eschmeyer, Paul H. and Reeve M. Bailey. 1955. THE PYGMY WHITEFISH, COREGONUS COULTERI, IN LAKE SUPERIOR. Trans. Amer. Fish. Soc., 1954. pp. 161-199.

Bottom trawling by the U. S. Fish and Wildlife Service motor vessel Cisco in Lake Superior in 1952-1953 revealed a large population of a tiny whitefish, Coregonus (Prosopium) coulteri, which has been reported previously only from northwestern North America. The hiatus in range, from Lake Superior to the Columbia River basin, is the greatest known for a North American freshwater fish. Although minor structural differences characterize the disjunct populations of the pygmy whitefish, these are not deemed worthy of nomenclatorial recognition. Comparisons with related species indicate that the pygmy whitefish is distinctive in the small size, large scales, few vertebrae, few pyloric caeca, and in other characters.

The pygmy whitefish is widely distributed in Lake Superior, especially in semi-protected bays, such as Keweenaw Bay which yielded about 68 percent of the 1,623 specimens caught. The bathymetric range was 10 to 49 fathoms, with maximum abundance at the 25- to 39-fathom interval. Average length of fish increased progressively with water depth, chiefly because the number of yearlings declined from 100 percent at 10-14 fathoms to none at 45-49 fathoms.

The average total length of pygmy whitefish caught by trawling was 3.4 inches (range 1.2 to 5.7). Extraordinarily slow growth was revealed by the examination of scales. Two fish from Keweenaw Bay, both nearing the end of their eighth growing season, were only 5.4 inches long. Compared to Keweenaw Bay, growth rate was about the same near Laughing Fish Point, faster in the Apostle Islands (and in Bull and McDonald Lakes, Montana), and slower in Siskiwit Bay, Isle Royale. Females grew more rapidly than males after the second year and had a longer life span.

All male pygmy whitefish were mature at the age of 2 years and a total length of 3.6 or more inches. Most females were mature at 3 years and 4.2 inches; all older females were mature. Mean egg production was 362 (range, 93 to 597) per fish and 26 per gram of total weight for fish from 3.4 to 5.9 inches long. Spawning in 1953 occurred sometime in November of December.

Crustacea (principally ostracods and amphipods—

copepods in the young) occurred in 106 to 112 pygmy whitefish stomachs and made up 77 percent of the total food volume. When available, fish eggs appear to be important in the diet.

Other cold-water fishes—cottids, ninespine sticklebacks, smelt, and four species of coregonines—were the most frequent associates of the pygmy whitefish. Lake trout and trout-perch were also taken with it at the same stations or in the same trawl hauls. Its closest relative in Lake Superior, the round whitefish, was not an ecological associate. (A)

655. Murphy, Leon W. 1955. TWO-YEAR CREEL CENSUS OF THE LITTLE SALMON RIVER, IDAHO. Trans. Amer. Fish. Soc., 1954. pp. 200-206.

The use of stratified periods, random sampling days and voluntary information provided by the participating anglers provided a method of creel census which required a minimum of working days and still allowed constant highway travel in the working area to flow uninterrupted. A maximum of two men on 24 days was used to census a season total of nearly 7,000 anglers on 24 miles of the stream.

In 1952, of 1,107 anglers interviewed 940 (84.9 percent) returned catch data. In 1953, 1,140 anglers were interviewed and 1,042 of these (91.4 percent) responded.

Total estimated catch was 47,772 in 1952 and 46,997 in 1953. Hatchery-reared rainbow trout comprised 2,223 of the 1952 catch and 4,867 of the catch in 1953. Recovery of these planted fish amounted to 37.1 percent of 6,000 released in 1952 and 57.9 percent of 8,400 in 1953. Anglers retained an estimated 58.5 percent of the total catch in 1952 and 72.2 percent in 1953.

Statistical analysis proved the estimate of the total reported catch to be within the limits desired for management purposes. (A)

656. Probst, Robert T. and Edwin L. Cooper. 1955. AGE, GROWTH, AND PRODUCTION OF THE LAKE STURGEON (ACIPENSER FULVESCENS) IN THE LAKE WINNEBAGO REGION, WISCONSIN. Trans. Amer. Fish. Soc., 1954. pp. 207-227.

Lake sturgeon populations, markedly reduced throughout most of their range, now support commercial or sport fisheries in few regions. A sport fishery in the Lake Winnebago area annually attracts approximately 2,000 spearers who take from about 400 to more than 2,800 fish. When spearing conditions are favorable more persons participate in the sport and enjoy a greater rate of success. The estimated catch of 2,828 lake sturgeon speared in 1953, weighing approximately 100,000 pounds, represented the largest catch on record. This annual yield of lake sturgeon is exceeded in North America only by commercial fisheries for white and green sturgeon in the States of Washington and Oregon.

Lengths of lake sturgeon speared ranged from 30 to 79 inches; fish from 37 to 40 inches long were most abundant in the catch.

Age determinations were accomplished by examining transverse sections of the marginal ray of the pectoral fin. Age-groups from 0 to LXXXII were represented in collections made in the Lake Winnebago area with age-groups XV to XXX most numerous. Growth in length is rather rapid during the first few years with the fish attaining the former legal size of 30 inches in about 7 years. A 40-inch sturgeon would be approximately 13 years old and a 50-inch fish, 20 years. No difference was noted in growth of the sexes.

The length-weight relationship of lake sturgeon in the Lake Winnebago area was computed to be: $\log W = -4.17096 + 3.30367 \log L$, where W is weight in pounds and L is total length in inches.

Female lake sturgeon live longer and thus grow to larger sizes than do the males. Females made up 96 percent of the total catch of fish over 60 inches long.

Tendepedid larvae were the most important food item taken by the lake sturgeon in Lake Winnebago. In the smaller lakes, mayflies and aquatic sow bugs were also taken frequently. (A)

657. Katz, Max and W. Charles Howard. 1955. THE LENGTH AND GROWTH OF 0-YEAR CLASS CREEK CHUBS IN RELATION TO DOMESTIC POLLUTION. Trans. Amer. Fish. Soc., 1954. pp. 228-238.

The lengths of creek chubs, Semotilus a. atromaculatus, of the same year class differ significantly in the various pollutional zones of Lytle Creek, Clinton County, Ohio. In the clean water zone above a sewage treatment plant outfall, where the stream is very small, the 0-year creek chub taken in August 1952 averaged 42.3 millimeters in total length. The creek chubs of the same year class, found in the upper portion of the recovery zone, averaged 53.3 millimeters, while in the enriched lower portion of the recovery zone they were larger, averaging 63.8 millimeters. In the lower clean water zone, the fish were smaller and had a mean length of 52.0 millimeters.

In the upper recovery zone, the creek chubs apparently did not survive the winter season. Despite a considerable minnow fishery, significant numbers of 1-year-old or older fish were present in the upper clean water zone, lower recovery zone, and lower clean water zone.

Growth was rapid in the upper recovery zone during the early summer, but slowed down markedly by the end of the summer, while growth at the other stations remained rapid into the early fall. Growth could not be correlated with the volume of bottom organisms found at the various stations. The consistent difference in the size of creek chub at the various stations indicates that these fish do not migrate in search of optimum conditions. (A)

658. Echo, John B. 1955. SOME ECOLOGICAL RELATIONSHIPS BETWEEN YELLOW PERCH AND CUTTHROAT TROUT IN THOMPSON LAKES, MONTANA. Trans. Amer. Fish. Soc., 1954. pp. 239-248.

The relationship between yellow perch and

cutthroat trout in Thompson Lakes, Montana, was investigated in the summers of 1952 and 1953. These lakes originally contained cutthroat trout and were later planted with yellow perch. The spawning time of the yellow perch was in early May, and for the cutthroat trout in late May. The population of yellow perch was large and growth was very slow. Although the number of cutthroat trout was small, the growth rate for this species was about average. The food of yellow perch was largely immature aquatic insects and plankton while that of cutthroat trout was mostly mature aquatic insects and small perch. Yellow perch were commonly distributed along the lake margins and concentrations of perch fry and adults were found in these areas in the spring. During this period the salmonid fishes were predominately in the deep water. Spot poisoning of the yellow perch concentrations practically destroyed all of the fish in the treated area. Management suggestions are given. (A)

659. Pycha, Richard L. and Lloyd L. Smith, Jr. 1955. EARLY LIFE HISTORY OF THE YELLOW PERCH, PERCA FLAVESCENS (MITCHILL), IN THE RED LAKES, MINNESOTA. Trans. Amer. Fish. Soc., 1954. pp. 249-260.

The early life history of the yellow perch, an important commercial species in the Red Lakes, Minnesota, has been studied with special reference to length at scale formation, growth rate during first season of life, and food habits as they relate to growth and survival. Scales are fully imbricated in the area of 12th to 14th lateral line scales at 24 millimeters total length. There is a wide annual variation in first season's growth which is not correlated with growth in older fish. Body-scale relationship is rectilinear from 24 to 280 millimeters. Length-weight relationship during the first year is expressed by the equation $W = 0.6198 \times 10^{-5} L^{3.1251}$ which is very similar to that describing the relationship in later years. Stomach analysis indicates food is primarily plankton but in some seasons fish may be strongly dependent on bottom forms. Variations in food availability appear to be associated with changes in growth and may have a major influence on survival. (A)

660. Larson, Ralph W. and John M. Ward. 1955. MANAGEMENT OF STEELHEAD TROUT IN THE STATE OF WASHINGTON. Trans. Amer. Fish. Soc., 1954. pp. 261-274.

The increase in the angling for steelhead trout (Salmo gairdneri irideus) since the end of World War II caused fishery biologists in the State of Washington to re-evaluate their management policies and to search for a means of building up runs of adult steelhead trout in depleted or heavily fished streams. Experiments were conducted to determine the proper size and time of planting of hatchery-reared steelhead trout to obtain best returns of adults. It was found that the planting of migrant-sized steelhead trout during the normal migration period of wild fish provided the best returns. Runs of adult steelhead trout have been built substantially up by plants of hatchery-reared fish as evidenced by trap returns on planted streams.

Regulations on the fishery for mature and immature steelhead trout have tended to become more liberal on the mature and more stringent on the immature fish. Seasons on adults extend through March and April in many streams having late runs, rather than being ended at the end of February as in the past. Points above which no fishing is allowed are shifted down stream as the fishing season progresses, thus protecting the spawners and allowing fresh-run steelhead trout to be taken. Immature fish are being protected by a July 1 opening on the lower reaches of steelhead trout streams where the migrant-sized fish congregate before moving into salt water. Some rivers have a 10-inch minimum size limit in effect during the entire summer season to protect the immature trout. (A)

661. Irving, Robert B. 1955. ECOLOGY OF THE CUTTHROAT TROUT IN HENRYS LAKE, IDAHO. Trans. Amer. Fish. Soc., 1954. pp. 275-296.

Henrys Lake, a 6,500-acre reservoir at the elevation of 6,472 feet in eastern Idaho, has a maximum depth of 21 feet and an average depth of 12 feet. Seasonal variation of weather and shallow, fertile waters are the major environmental factors that influence the Henrys Lake biotic community. Phytoplankton is abundant and composed primarily of blue-green algae and cladocerans and copepods are the dominant zooplankters. Higher aquatic vegetation has developed over the entire bottom of the lake. The standing crop of bottom and plant-inhabiting fauna in Henrys Lake for 1951 is estimated to have been 606 pounds per acre.

Fish species found in Henrys Lake are: Cutthroat trout, Salmo clarki; Rocky Mountain sculpin, Cottus bairdi semiscaber; and mountain whitefish, Prosopium williamsoni as native species. Introduced fish are: rainbow trout, Salmo gairdneri; eastern brook trout, Salvelinus fontinalis; and redside shiner, Richardsonius balteatus hydrophlox. Rainbow trout and rainbow X cutthroat hybrids were rare in the sport catch. Cutthroat trout and brook trout entered the creel in the ratio of 4 to 1.

The body-scale relationship is described by a second-degree parabola. Cutthroat trout attain an average standard length of 21.6 millimeters prior to scale development. Analysis of scales provides evidence that the growing season of the cutthroat trout is limited to the open-water period of approximately 180 days, mid-May to mid-November.

Male cutthroat trout of the 1951 sport catch matured at ages II and III while females matured at ages III and IV. Of 500 mature cutthroat trout marked and released from the Henrys Lake Spawning Station in the spring of 1950, only 12 were taken in the sport-catch. This low recovery indicates these marked trout suffered a severe

natural mortality subsequent to spawning.

The considerable variation of growth in length among the Henrys Lake cutthroat trout is attributed to individual differences in the time spent in tributary streams as compared to time spent in lake, seasonal variation of environmental conditions, and different age at maturity between male and female fish. The rate of growth in weight continues to increase during the trout's second and third years whereas the rate of growth in length declines after the first year.

The sex ratio of female to male cutthroat trout in the 1951 sport catch declined not only with increase in age, but also as the fishing season progressed.

The midge-shrimp-damselfly food group comprised 90 percent by number and 74 percent by volume of the food utilized by the Henrys Lake cutthroat trout during the study period. The pronounced decline in feeding activity that occurred during August may have been due to the relatively high temperature and relatively low oxygen tension of the lake waters during this period.

Pathogenic bacteria infected mature cutthroat trout of the 1950, 1951, and 1952 spawning migrations. The death of an estimated 3,600 cutthroat trout of all age-groups in small, open-water areas at the mouths of 3 tributary streams during January 1952, has been attributed to asphyxiation due to local oxygen depletion.

The curves of growth in length and growth in weight of the Henrys Lake cutthroat trout are descriptive of a short-lived population. The mortality of the Henrys Lake cutthroat trout due to disease, asphyxiation, predation, and capture by anglers plus mortality of mature cutthroat trout subsequent to spawning (due possibly to causes both environmental and genetic in nature) combine to give a low average age and limit the number in the population. (A)

662. Andrew, F. J., L. R. Kersey and P. C. Johnson. 1955. AN INVESTIGATION OF THE PROBLEM OF GUIDING DOWNSTREAM-MIGRANT SALMON AT DAMS. Bull. No. 8, Int. Pacific Salmon Fish. Commission, 65 pp.

Experiments were conducted in Sweltzer Creek at Cultus Lake on the Fraser River watershed in 1953 and 1954 and at Baker Dam on Baker River in the State of Washington in 1955 to determine the practicability of using artificial stimuli to guide downstream-migrant sockeye salmon. Profound problems encountered in prototype experiments eliminate, at present, the possibility that artificial stimuli can be used as an effective and practical method for protecting downstream-migrant salmon at dams. A unique type of electrical screen —the "galvanotropic screen"—was developed which was over 90 percent effective in previous small-scale experiments but it was not effective in large-scale experiments at Baker Dam. This screen incorporates an efficient galvanotropic stimulus to attract fish out of the electrified zone. Other artificial stimuli—air bubbles, light, shade, and visible barriers—were found to produce some directional effect but they were much less effective than galvanotropic stimuli in the small-scale experiments. (A)

663. Parker, Phillip S. and Robert E. Lennon. 1956. BIOLOGY OF THE SEA LAMPREY IN ITS PARASITIC PHASE. U. S. Fish & Wildlife Service, Res. Rep. 44, 32 pp.

The investigations conducted on sea lampreys in aquariums were concerned with the duration of the parasitic phase of life, feeding, growth, and the interrelations between predator and host fish. Observations on lampreys reared from metamorphosis to maturity were made at the Fish and Wildlife Service Laboratory at Hammond Bay, Michigan.

Most of the experimental lampreys were mature and ripe after 14 to 18 months of parasitic life. They exhibited signs of irreversible physical degeneration which precedes death. Three specimens were immature after 14, 18, and 26 months in aquariums, thus indicating that under certain conditions, lampreys may extend their parasitic phase.

The feeding activity, growth, and shrinkage in size of aquarium specimens were considered typical of lampreys in the Great Lakes, although the wild lampreys achieve greater average size. Female lampreys made more attacks, fed more, killed more fish, and grew larger than males. They also shrank proportionately more in length and weight as they approached sexual maturity, but their terminal average size was slightly larger than that of males.

It is estimated that the average fish-kill by a wild lamprey exceeds, and could be approximately double, the 18.5 pounds of fish killed by a laboratory lamprey. The rate and extent of fish destruction depended on the size, sex, and stage in the parasitic phase of the lampreys, and on the species and size of the fish. There was an increase in the number of fish killed as the lampreys grew, and the fish were killed more quickly. Attacks made by experimental lampreys at any stage of their parasitic phase up to full maturity, and on any part of a prey fish except fins, usually resulted in death to the host.

Some fish which survived lamprey attacks succumbed to fungus infections of the wounds. A small number of trout recovered from attacks, and their wounds healed. (A)

664. Lindner, Milton J. and William W. Anderson. 1956. GROWTH, MIGRATIONS, SPAWNING AND SIZE DISTRIBUTION OF SHRIMP PENAEUS SETIFERUS. U. S. Fish & Wildlife Service Fish. Bull. 106, 90 pp.

In order to establish growth and migration patterns, approximately 45,000 shrimp were tagged and released between 1935 and 1939, in separate areas of the coast from North Carolina to Mexico. Of the shrimp released, more than 7,000 were recaptured, having been at liberty up to 200 days.

Tagged shrimp grow rapidly from March through September, but growth almost ceases

from October through February. At the growth rate inferred from an analysis of the short-term increments of the shrimp recaptured, they grow from 10 cm. in length in April to 16 cm. in July, and to 19 cm. by November of a single year. Or, if they are 10 cm. long in July, they measure 16 cm. by November.

Tagged shrimp released along the south Atlantic coast in the fall were recovered consistently to the south of the area of release; those released in early spring tended to be retaken to the north. Large shrimp, those longer than 13 cm., moved more extensively than did the smaller ones.

Gulf-coast releases demonstrated no consistent migration pattern, other than the movement from inside waters to outside oceanic areas. The movement to outside waters was discovered at all areas of release, and pertains largely to small shrimp. Few large shrimp were found in inside waters.

Although the eggs and larvae of the white shrimp have rarely been taken, the location of females with ripe ovaries leads one to infer that spawning takes place offshore. Ripe females were obtained in most areas from April through August, but there may be separate populations spawning in different months.

On the basis of size distribution, both of commercially caught shrimp and of those taken by research vessels, at least two separate groups of young shrimp move from inside to outside waters each year. One group enters the offshore areas in June, the other in August or September. The latter group was probably spawned in the spring of the same year; the former, in the summer of the previous year. (A)

665. Riley, Gordon A. 1955. REVIEW OF THE OCEANOGRAPHY OF LONG ISLAND SOUND. Contr. No. 762 from the Woods Hole Oceanographic Instn., Papers in Marine Biology and Oceanography, Vol. 3, part 2, pp. 224-238.

Long Island Sound is a shallow, semi-enclosed body of slightly brackish (23-31$^{o}/_{oo}$) water with an area of about 900 nautical square miles. Moderate tidal currents permit a small seasonal thermocline and slight vertical gradients in salinity, oxygen and nutrient salts. The major feature of non-tidal circulation is a two-layered transport system in which a freshened surface layer moves eastward out of the Sound and is replaced by a more saline inflow along the bottom. The latter contains more nutrients than the outflowing surface water, so that the transport system tends to accumulate and conserve nutrients. Fresh water drainage also makes a significant contribution of nitrate.

Phytoplankton concentrations are large, but the species composition is relatively limited. A large diatom flowering occurs in late winter, following an early winter minimum, with only minor fluctuations the rest of the year. There is sufficient mixing to prevent a large accumulation of nutrients in the bottom water, so that there is neither pronounced poverty in summer nor a big autumn flowering following destruction of the thermocline. Major limiting factors are the amount of effective light in autumn and winter and the nitrogen supply in spring and summer. Variations in light and temperature from one year to the next affect the winter species composition and the time of the flowering. Diatoms are largely replaced in summer by naked flagellates and other nannoplankton. During one summer when nitrate concentrations were higher than usual, diatoms were abundant and there was also an unusually large zooplankton crop. A causal connection is indicated but not well established.

The zooplankton consists of large numbers of small animals. Relatively few species are present. The dominants are two species of the copepod Acartia which alternate seasonally. Descriptive and experimental studies suggest that seasonal replacement is primarily a temperature-controlled competition rather than a direct, lethal temperature effect. Experiments show that the Acartias have high respiratory rates and low grazing rates compared with most other copepods that have been examined and possibly are able to achieve dominance only in waters sufficiently brackish to exclude more efficient oceanic species.

Preliminary studies of bottom fauna indicate a relatively large biomass, again consisting of large numbers of small animals. Fish eggs and larvae are abundant, and the Sound may be an important spawning and nursery ground. However, commercial fishery statistics show no indications of a large population of mature fish.

Total phytoplankton production is about the same as in the open coastal and bank waters off New England. Most of this production is utilized in the support of small animals which do not provide an adequate food supply for the efficient production of large carnivores. (A)

666. Graham, J. J. 1956. OBSERVATIONS ON THE ALEWIFE, POMOLOBUS PSEUDOHARENGUS (WILSON), IN FRESH WATER. Univ. of Toronto Biol. Series No. 62, 43 pp.

The major study in this investigation was one of growth and form, carried out to evaluate differences in growth rates and body proportions between the land-locked Lake Ontario and the anadromous Atlantic alewives. Particular attention was also given to the nature of the annual mortality that is characteristic of P. pseudoharengus in Lake Ontario. The Atlantic alewife has a more rapid rate of growth than the land-locked form. Both groups display early rapid growth followed by a decrease in the growth rate coincident with the onset of sexual maturity. It is suggested that the fresh water environment hastens the onset of maturity with its attendant inhibition of growth. The Lake Ontario alewife matures about one year earlier than the Atlantic alewife.

Variation of form of the alewife within Lake Ontario is essentially small. Of 13 measurements made, only three showed slight differences between samples. In contrast there was a wide difference between the form of the Lake Ontario and the Atlantic representatives. Eight of the

13 characters compared showed significant differences in their growth partition constants. Three of the remaining five characters showed differences in the intercept of the relative growth lines.

The head length of the Lake Ontario sample was measured at three sizes representing small, medium, and large fish; the range decreased progressively with increasing body length. The slope of the line representing the relative growth of the head length in the Atlantic sample roughly paralleled the upper limit of variability as set by twice the standard deviation, but converged with the lower limit similarly set. It is concluded that the differences in form between the two groups are chiefly the result of differential selection of the fresh water alewife by its environment. Inadequacy of osmotic regulation by the Lake Ontario alewife is thought to be acting, possibly in conjunction with temperature, to remove small-headed fish from the population.

During the alewife's spring entry into shoal water in Lake Ontario it sometimes encounters gradients that have maximum surface temperatures approaching 20° C. Alewives were observed to die principally within the upper ranges of these gradients. A correlation between the gradual increase in surface temperature from spring to summer with increase in mortality was also found. Comparison of the range of lethal temperatures found in the laboratory with the lethal ranges of the temperature gradients observed in the field showed that the early incidences of mortality are related to the entrance of the alewives into warm shoal waters in spring while they are still acclimated to the low temperatures of the lake's depths. Later and more extensive mortalities are believed to be also caused by lethal temperatures although no support for this belief was obtained in the laboratory. (A)

667. Willis, Yuell L., Don L. Moyle and Thomas S. Baskett. 1956. EMERGENCE, BREEDING, HIBERNATION, MOVEMENTS AND TRANSFORMATION OF THE BULLFROG, RANA CATESBEIANA, IN MISSOURI. Reprint from Copeia, No. 1, February 29, pp. 30-41.

The life history of the bullfrog is reported with a note that observations on movement indicated the ingress of newly transformed bullfrogs may be an important factor in the stocking of new ponds.

668. Zeller, Howard D. 1955. A MODIFICATION OF THE 1-NAPHTHYLAMINE-SULPHANILIC ACID METHOD FOR THE DETERMINATION OF NITRITES IN LOW CONCENTRATION. Reprint from "The Analyst", J. of the Soc. for Analytical Chem., Vol. 80, No. 953, pp. 632-633.

In limnological studies, colorimetric determination of nitrite nitrogen is generally difficult due to its low concentration. The following procedure has been developed for highly turbid waters of nitrite concentrations below 0.02 p.p.m.; color concentration is increased fivefold.

The standard procedure is followed, with the addition of 1 ml of sulphanilic acid and 1 ml. of 1-naphthylamine acetate to 50 ml of the water sample. Maximum color development occurs within 20 minutes at room temperature. After the color develops, an excess of sodium chloride is added to the solution to ensure saturation. Then 10 ml. of n-butanol in aliquots of 4, 3, and 3 ml, are added to extract the color. The n-butanol, is removed with a pipette after each addition and the total 10 ml. of extract is examined with a photo-electric colorimeter with green filter.

669. Reimers, Norman and Bobby D. Combs. 1956. METHOD OF EVALUATING TEMPERATURE IN LAKES WITH DESCRIPTION OF THERMAL CHARACTERISTICS OF CONVICT LAKE, CALIFORNIA. U.S. Fish & Wildlife Service Fish. Bull. 105, 18 pp.

Two years of temperature observations at Convict Lake, a 168-acre alpine lake in eastern California, are used as the basis for a description of thermal characteristics including annual temperature cycle, distribution of temperature, and thermal stratification in relation to morphometry and weather. The heat-budget method of assessing heat in lakes has inherent limitations on lake size, depth, and geographical location that restrict its usefulness to general comparisons among large bodies of water. The method of measuring sustained heat intensity (temperature summation) presented here is free of these limitations. Data developed from temperatures of Convict Lake and other lakes of the same drainage basin support the conclusion that such a method can be serviceable for comparing lakes of various sizes and situations over selected periods of time, or for evaluating temperature in relation to other measures of lake productivity. A summation procedure is suggested in which the base temperature is 32° F. and the summation units are day-degrees in excess of the base. (A)

670. O'Connell, Charles P. 1955. THE GAS BLADDER AND ITS RELATION TO THE INNER EAR IN SARDINOPS CAERULEA AND ENGRAULIS MORDAX. U. S. Fish & Wildlife Service Fish. Bull. 104, Vol. 56, 28 pp.

In anticipation of physiological and behavior studies of the Pacific sardine (Sardinops caerulea) and the northern anchovy (Engraulis mordax), an anatomical study of the gas bladder has been made in both species. As in all clupeoid fishes, the gas bladders of these species have a close anatomical relation with the inner ears. A general description of this mechanism is presented, and some differences in cranial structure in the sardine and anchovy are noted.

The form and orientation of the gas bladder, which differ in the two species, are described. In the sardine, the pneumatic duct arises from the end of the blindsac of the stomach, and the gas bladder has only one chamber with a postanal opening to the exterior. In the anchovy, the pneumatic duct arises from the dorsal wall of the cardiac stomach, and the bladder is composed of two chambers with only a short blind caecum at its

posterior end.

Histological descriptions are given of the pneumatic duct and bladder wall in both species, and of the postanal opening in the sardine and the posterior caecum in the anchovy. The structure of the pneumatic ducts strongly suggests a valve-like mechanism that prevents the passage of solid matter toward the gas bladder. The gas-bladder wall exhibits no secretory specialization in either species, but specialization of the muscle layer in the anchovy is indicative of a pumping mechanism between the two chambers of the bladder. In the sardine, the postanal opening of the bladder, which is not controlled by a muscular sphincter, probably opens and closes as a result of differences in gas pressure in the bladder and hydrostatic pressure in the external environment. In the anchovy, the posterior caecum of the bladder is a small and fairly complex structure, but its function cannot be surmised without further investigation.

The probable functions of the ear-gas bladder mechanism and the gas bladder proper, as well as the functional relation between them, are discussed. Definite conclusions will not be possible without experimental investigation. Because the structural differences in the gas bladders of these two species suggest the possibility of associated behavior differences, both species should be subjected to experimental investigation. (A)

671. Wilhelmi, Alfred E., Grace E. Pickford and Wilbur H. Sawyer. 1955. INITIATION OF THE SPAWNING REFLEX RESPONSE IN FUNDULUS BY THE ADMINISTRATION OF FISH AND MAMMALIAN NEUROHYPOPHYSIAL PREPARATIONS AND SYNTHETIC OXYTOCIN. Reprint from Endocrinology, Vol. 57, No. 2, Aug., pp. 243-252.

The preparation of partially purified fish and beef pituitary protein fractions that are rich in fish spawning reflex activity is described. A method of assay of spawning reflex activity, based on the minimum dose that will elicit a response within 40 minutes, is described and a Fundulus unit is defined. The spawning reflex response can be elicited with purified natural arginine vasopressin, purified natural oxytocin, and synthetic oxytocin at approximately similar dosage levels (20 to 60 milliunits per gram weight, on the 40 minute assay). Fish and beef pituitary preparations with spawning reflex activity contain both oxytocic and vasopressor activity in approximate proportion to their spawning reflex assay. (A)

672. Raymond, Howard L. 1956. EFFECT OF PULSE FREQUENCY AND DURATION IN GUIDING SALMON FINGERLINGS BY ELECTRICITY. U.S. Fish & Wildlife Service Res. Rep. 43, 19 pp.

The relation of pulse frequency and pulse duration to the effectiveness of a moving field of pulsating direct current in directing salmon fingerlings was explored under controlled laboratory conditions, utilizing a single-row electrode array.

The experiments indicated that, within the range of conditions examined, pulse frequencies of 3 to 4 pulses per second and pulse durations of 15 to 30 milliseconds were most effective in diverting fingerlings; and that the effectiveness of the electrical array was related to the duty cycle. Those conditions most nearly approaching a duty cycle of 0.10 were most effective. No mortality occurred at any of the pulse frequencies and pulse durations tested below a duty cycle of 0.10. (A)

673. Rawson, D. S. 1956. ALGAL INDICATORS OF TROPHIC LAKE TYPES. Reprint from Limnol. and Oceanography, Vol. 1, No. 1, Jan., pp. 18-25.

The dominant species of algae in the Great Lakes and in the large oligotrophic lakes of western Canada are not those commonly quoted as oligotrophic indicators. It is suggested that this apparent discrepancy may be due to the lack of sufficiently detailed taxonomic information, to the non-existence of oligotrophic indicators, or to the fact that oligotrophy of these lakes is essentially morphometric rather than edaphic. The utility of phytoplankton quotients and the problem of numbers of species versus dominant species are discussed. (A)

674. Erkkila, Leo F., Bernard R. Smith and Alberton L. McLain. 1956. SEA LAMPREY CONTROL ON THE GREAT LAKES 1953 and 1954. U. S. Fish & Wildlife Service Spec. Sci. Rep. -- Fish. No. 175, May, 27 pp.

Development of electromechanical devices permitted practical application of sea lamprey control in Great Lakes streams. The barriers were energized by 110-volt, 60-cycle, alternating current.

Sea lampreys were effectively blocked in their upstream spawning migration. Traps were installed in the control structures to pass migratory fish upstream. The extent of fish mortality at the electrical barriers was influenced by stream velocities, conductivity of the water and stream bottom, and size and location of the traps.

Biological data on the sea lampreys were collected at the control structures. Each stream appeared to have its own electrical characteristics. Several factors influencing the electrical fields were determined. Present information indicates limited possibility of improving the electrical field to reduce fish mortality. (A)

675. Walters, Vladimir. 1955. FISHES OF WESTERN ARCTIC AMERICA AND EASTERN ARCTIC SIBERIA: TAXONOMY AND ZOOGEOGRAPHY. Bull. of Amer. Mus. of Nat. Hist., N.Y., Vol. 106:Art. 5. 107 pp.

This comprehensive study is divided into two parts. In the first part the fresh water and marine fishes of eastern Arctic Siberia, Arctic Alaska, and western Arctic Canada are enumerated, and the ranges of the various subspecies and species are delimited. A dichotomous key to marine fishes of Eastern Arctic Siberia and Western Arctic America, and to fresh water fishes of Arctic Alaska is presented. In the second part, the distribution

patterns are analyzed in the light of present-day knowledge of the last glacial period.

676. Black, Edgar C. 1956. APPEARANCE OF LACTIC ACID IN THE BLOOD OF KAMLOOPS AND LAKE TROUT FOLLOWING LIVE TRANSPORTATION. The Canad. Fish Culturist, Issue 18, March, pp. 20-27.

Twenty-five each of 2-year-old kamloops rainbow trout and 1.5-year-old lake trout were transported in a tank truck for two hours to simulate ordinarily encountered conditions. Blood samples taken following this conditioning revealed that the lactic acid level in kamloops trout was highest during the first 24 minutes after transportation and that it subsided erratically for the next hour to approach the unexercised level. The maximum level attained was 66 percent of the level to be expected after 15 minutes of vigorous activity, but only 40 percent of the level attained two hours after vigorous activity.

Blood lactic acid in lake trout reached a maximum about one hour after transportation then decreased precipitously within five minutes to the approximate unexercised level. The blood level of lactic acid immediately after transportation was 40 percent of that to be expected 15 minutes after vigorous activity and increased to 45 percent of the level attained one hour after vigorous activity.

These observations on lactic acid levels, hemoglobin values, and sedimentation rate of the blood and of behaviour of kamloops and lake trout following a simulated transportation run compared with similar changes following vigorous exercise for 15 minutes, indicates that the lactic acid production and other correlates of muscular activity may be implicated in the death of salmonids following transportation. Several other factors contributing to the variability in mortality during and after transportation are discussed as likely contributors to "delayed planting mortality."

677. Smith, M. W. and J. W. Saunders. 1956. EFFICIENCY OF YEAR-ROUND OPERATION OF TROUT COUNTING FENCES ON A SMALL STREAM. The Canad. Fish Culturist, Issue 18, March, pp. 6-19.

During a 5-year study of tagged and recaptured brook trout on Ellerslie Brook, a small Prince Edward Island stream, inferred movements of trout through two weirs with upstream and downstream traps comprised 22 percent of the 10,528 movements of tagged trout noted in the traps. The actual undetected movements were likely somewhat greater, though probably not appreciably so, due to the possibility of a tagged trout making an even number of successive undetected movements.

The percent of undetected movements varied irregularly in relation to season, year, weir, and direction. Freshets, accompanied by debris, frazil ice, storm tides, and muskrats interferred with maintaining the weirs in effective operation throughout the year even though the weirs were operated under close supervision.

678. Verduin, Jacob. 1956. ENERGY FIXATION AND UTILIZATION BY NATURAL COMMUNITIES IN WESTERN LAKE ERIE. Ecology, Vol. 37, No. 1, Jan., pp. 40-50.

Measurements were made of photosynthesis and respiration in natural communities of western Lake Erie, using pH change in natural water as an index of CO_2 change. Photosynthesis vs. light curves showed that autumn communities use dim light more efficiently than do spring communities. Photosynthesis rates, per unit of plant volume, exhibited by communities collected from, and tested in 0° water were as high as those of communities collected from, and tested in 23° water. The ratio of photosynthesis at optimal light to respiration showed an average value of 8, with values as high as 20, and as low as 1.5 being observed. Photosynthesis at optimal light showed average yields of 5 μ moles CO_2 absorbed/10 μ l./hr., and 1.6 μ moles/mg. ash-free dry wt./hr. These are similar to values computed from the literature for marine phytoplankton and for myxophycean communities in fresh water.

Filtering lake water through No. 25 bolting cloth removed about one-third of the photosynthetic activity, thus two-thirds of the autotrophic community remains unidentified. Measurements of photosynthesis under completely natural conditions indicated an average yield of 68 micromol. CO_2 absorbed/liter of water/day at 23°, falling off at cooler temperatures to 10 at 0°. It is shown that CO_2 exchange between water and air is negligible in comparison to the daily CO_2 changes within the aquatic environment. It appears that photosynthesis of the autotrophic community and respiration of the total community are approximately equal.

The rates of photosynthesis per square meter per day amounted to about 220 millimoles at summer temperatures, and averaged 140 for the July-January period. These values are similar to estimates for other eutrophic waters computed from the literature. Measurements of respiration rates of bottom fauna, combined with a knowledge of the weight of animals per square meter yielded an estimate indicating that they contribute about four percent to the total respiration per square meter of water. (A)

679. Sloan, William C. 1956. THE DISTRIBUTION OF AQUATIC INSECTS IN TWO FLORIDA SPRINGS. Ecology, Vol. 37, No. 1, Jan., pp. 81-98.

Two constant-temperature Florida springs, Homosassa and Weekiwachee Springs, have been studied and an attempt has been made to correlate the spatial and temporal distribution of aquatic insects with measured physical and chemical environmental factors. The major results of the study may be briefly summarized as follows: The dissolved oxygen concentrations form gradients in both springs but this is more pronounced in Weekiwachee than in Homosassa. In the lower parts of the runs, the chloride concentration increases due to the effect of marine tidal invasion. Tempera-

ture was found to be essentially constant in the springheads of both rivers; the daily and seasonal changes in temperature at downstream stations, even those several miles below the pools, were not of large magnitudes. The pH is nearly constant in the springheads and runs, but varies somewhat in the estuaries; this is probably due to changes in the salt concentrations during tidal inflow and outflow. By using as indices dissolved oxygen fluctuation and temperature variation, areas of environmental variability were found to lie at points considerably below the springheads. Gradients of both numbers of species and densities of populations exist in both rivers. The numbers of species and individuals are fewer in springhead and estuarine areas than in mid-sections of the rivers. This is statistically verified. Factors which may in part explain the observed distribution patterns are discussed. The similarities between certain of the fauna of spring-head areas and that of organically polluted waters is pointed out. This may be accounted for by the fact that in both situations dissolved oxygen concentrations are low. Evidence is presented which indicates that, at least with respect to insect populations, spring-heads are areas of biological as well as chemical constancy. (A)

680. Edmondson, W. T. 1956. THE RELATION OF PHOTOSYNTHESIS BY PHYTOPLANKTON TO LIGHT IN LAKES. Ecology, Vol. 37, No. 1, Jan., pp. 161-174.

When productivity is considered on a regional basis the geographical distribution of photosynthetically active light is of basic importance. The relationship of photosynthetic rate of light intensity is of use in evaluating the effect of variations of light on photosynthesis. Much of the time, photosynthesis in the upper part of lakes will be held in check by intense light. Light can vary over a wide range of intensity without proportional variations of photosynthesis. Within a lake, the vertical variations in potential rate will be largely determined by the surface intensity and transparency. Variations in distribution of population, nutrients and temperature will modify the basic pattern. Ponds and many lakes are shallow enough that the depth of inhibition is a significant fraction of the maximum depth, and the average rate under a unit area may be reduced as the surface intensity increases above the optimal value.

An additional factor which must be taken into account is the effect of stratification. If the epilimnion is thicker than a certain critical depth, the phytoplankton population will be unable to grow. The value of the critical depth depends in part on surface illumination. Only in moderately deep lakes or untransparent lakes can anything like a proportionality between the surface illumination and average photosynthetic potential be expected. Nothing in this disucssion is to be taken as a lack of recognition of the importance of geographic variation in other factors known to affect productivity, such as nutrients and temperature, but it is obvious that even with the most favorable natural media and temperature, photosynthesis will not proceed without light, and too much light will be inhibitory.

681. Edmondson, W. T. 1956. MEASUREMENTS OF CONDUCTIVITY OF LAKE WATER IN SITU. Ecology, Vol. 37, No. 1, Jan., pp. 201-206.

A commercially marketed conductivity cell consisting of two blackened platinized gold-plated nickel electrodes mounted in a hollow polystryene cylinder 2 x 12 cm. was modified to permit making conductivity measurements in situ. These modifications are described. This modified cell was used in conjunction with a rapid response Whitney resistance thermometer, both the conductivity cell and the thermal element of the thermometer being mounted on a common bracket and the cables taped together. A 6-volt automobile battery with vibrator-pack current converter was used to supply the required 110 volts A. C. current. For maximum sensitivity and accuracy, the measured resistance should lie between 50 and 100,000 ohms. Total cost of the conductivity section of the instrument is about $180.

682. Sellmer, George P. 1956. A METHOD FOR THE SEPARATION OF SMALL BIVALVE MOLLUSCS FROM SEDIMENTS. Ecology, Vol. 37, No. 1, Jan., p. 206.

A method has been developed which, after ordinary screening, permits separation of small pelecypods from the preponderately greater number of equally sized sand particles which remain. Advantage is taken of the difference in specific gravity between the clams and sand.

The small marine clam Gemma gemma which ranges from 350 microns to 5 mm. in size was used in the development of this technique. The reagent employed was a concentrated solution of $ZnCl_2$. The specific gravities of G. gemma and sand collected from Raritan Bay, New Jersey, were determined and found to be 1.65 and 2.6, respectively. One hundred percent recovery of adult G. gemma was obtained using a 75 percent solution of $ZnCl_2$ (s. g. = 2.1). The concentration of the $ZnCl_2$ solution to be used in this separation depends on the particular species of bivalve and its size. In addition to the results given above, 88 percent recovery of juveniles of G. gemma purpurea was achieved with an 85 percent solution (s. g. = 2.45).

Since the hydrolytic reaction that follows the addition of $ZnCl_2$ to water in the preparation of the solution creates a highly acid medium, shell erosion and gas evolution is to be expected. This occurs only in the umbonal region with adult G. gemma and not at all on the external shell surface of its juveniles whose periostracum is still completely intact. Shell dimensions, however, were not perceptibly altered by leaving both adult and juvenile clams in the solution for several hours.

683. Dobie, John. 1956 WALLEYE POND MANAGEMENT IN MINN. OTA. Prog. Fish.-Cult., Vol. 18, No. 2, pp. 51-57.

Studies of drainable walleye ponds have shown that fish production is closely associated with soil fertility. Ponds low in soil organic matter do not produce enough insects to feed the fish in mid-summer when other foods are scarce. The ponds are checked periodically for food shortages and starving fish in order that the ponds may be harvested before fish are lost through cannibalism. The algal populations of fertile ponds are checked at the same time. Rising populations of algae are killed with copper sulfate in order to prevent excessive blooms that cause summer kills when decomposing. Studies have shown that the rate of growth of walleyes in ponds is regulated by the size of the population. Changes in the population can be detected by changes in the growth curve. (A)

684. Wood, E. M. and W. T. Yasutake. 1956. HISTOPATHOLOGY OF FISH. III. PEDUNCLE ("COLD-WATER") DISEASE. Prog. Fish-Cult., Vol. 18, No. 2, pp. 58-61.

Histologically, the disease caused in coho salmon (Oncorhynchus kisutch) by the myxobacterium Cytophaga psychrophila is an acute septicemic infection characterized by concentrations of organisms in the head area, particularly the mouth, and in the renal elements of the kidney. (A)

685. Morton, K. E. 1956. A NEW MECHANICALLY ADJUSTABLE MULTI-SIZE FISH-GRADER. The Prog. Fish-Cult., Vol. 18, No. 2, April, pp. 62-66.

Because the benefits to be derived from the accurate grading of hatchery-reared trout are great, considerable effort has been expended in the development of an efficient grader. A new design for grading fish into five size groups automatically and with a minimum of labor is described. The new design has eliminated all springs, hinges, wedges, and wings. It is made entirely from aluminum and plexiglas, with sheet-rubber troughs that are used to carry the various sizes of fish to their respective live-cars. Being made of aluminum and plexiglas, the machine requires no painting and, given reasonably good care, should last indefinitely with a minimum of maintenance.

686. Ridgway, George J. 1956. SOME CYTOLOTICAL OBSERVATIONS ON FISH ERYTHROCYTES. Prog. Fish-Cult., Vol. 18, No. 2, pp. 67-69.

Mitochondria were demonstrated to be present in the mature erythrocytes of chinook salmon (Oncorhynchus tshawytscha), blueback salmon (O. nerka) and rainbow trout (Salmo gairdneri) by vital-staining with Janus green B. The number of mitochondria per cell ranges from 6 to 20 with an average of 14, and their size is approximately 1 to 2 μ by 0.3 μ. The presence of varying amounts of reticular material in these erythrocytes was demonstrated by vital-staining with brilliant cresyl blue and methylene blue. These dyes also stained the mitochondria and the nuclei. No cells were found that were completely devoid of mitochondria and reticular material. (A)

687. Huey, William S. and W. H. Wolfrum. 1956. BEAVER-TROUT RELATIONS IN NEW MEXICO. Prog. Fish-Cult., Vol. 18, No. 2, pp. 70-74.

During the summer of 1955, two inventories were made in each of six experimental sections of the upper Red River. Three of these contained beaver ponds, and three were undisturbed stream. Each section consisted of 50 linear yards of stream area. Four species of fish—cutthroat trout (Salmo clarki), brook trout (Salvelinus fontinalis), rainbow trout (Salmo gairdneri), and white suckers (Catostomus commersoni)—were in the stream. The average trout population per section in beaver sections was 154 in June and 180 in August, as opposed to 33 in June and 47 in August for the non-beaver sections. Trout taken from the beaver ponds averaged slightly larger than trout from non-beaver sections. Food production was significantly higher in beaver sections, and trout growth appeared to be faster in these sections. (A)

688. Rucker, R. R., B. J. Earp, and R. E. Burrows. 1956. LIGNASAN FOR BACTERIAL GILL DISEASE. Prog. Fish-Cult., Vol. 18, No. 2, pp. 75-77.

Lignasan is suggested as a substitute for Roccal, which varies in composition, or for pyridylmercuric acetate, which is expensive, in the control of bacterial gill disease among fish. Lignasan, 6.25 percent ethyl mercury phosphate and 73.75 percent inert materials, should be used at a concentration of 1:500,000 for a 1-hour exposure period. It is advisable to test Lignasan on a small group of fish under the prevailing conditions of the individual hatchery—that is, for water, temperature, and species of fish—before treating large groups of fish. (A)

689. Benson, Norman G. and J. T. Conner. 1956. USE OF CMU TO CONTROL NAJAS. The Prog. Fish-Cult., Vol. 18, No. 2, April, pp. 78-80.

Several rooted aquatic plants have caused the appearance of serious weed problems in warm water hatcheries in Tennessee. This report concerns the control of Najas through the use of CMU (3-p-chlorophenyl) - 1, 1 - dimethylurea), an herbicide which kills through the root system. A mixture of 80 percent CMU and inorganic fertilizer was applied to the surface or bottom of several ponds at sites of approximately 7, 10, 15, and 20 pounds per acre at the Springfield Hatchery, Springfield, Tennessee. From the results, it appears that about 15 pounds per acre should be applied. Influence of CMU on growth of phytoplankton was negligible and there was no indication that more fertilizer was necessary to develop a bloom in treated ponds than in untreated ponds. No fish mortality attributable to applications of CMU was observed. No terristrial vegetation around any of the ponds was killed. It will cost about $45 per acre per year to control Najas, but as one application a year is sufficient, it is not considered too expensive.

690. Threinen, C. W. 1956. THE SUCCESS OF A SEINE IN THE SAMPLING OF A LARGEMOUTH BASS POPULATION. The Prog. Fish-Cult., Vol. 18, No. 2, April, pp. 81-87.

Use of a seine 2,000 feet in length proved to be a successful method of capturing largemouth bass in the littoral zone of Brown's Lake. Seine hauls made anywhere within this 396-acre basin captured largemouth bass, although considerable mechanical difficulty in handling the net was encountered. The encircled fish moved well ahead of the seine and did not attempt to escape until they were crowded into a small area.

The results from each seine haul showed (1) that the size of fish and the pounds per acre varied considerably from one seining site to another, and (2) that the number of fish captured per unit of area varied with the seining site, though not so greatly as the weight and size of individuals. It is estimated that each haul captured approximately half of the number of fish present in the area covered. There was unequal distribution of year classes around the basin of this 396-acre lake. However, individuals (or small schools) appeared to be well scattered, because no seine haul captured more than 88 percent nor less than 34 percent of the average density as determined by mark-and-capture population estimates.

691. Zobairai, A. R. K. 1956. INCIDENCE OF B-COMPLEX AVITAMINOSIS AMONG COMMON CARP REARED IN TROUGHS. Prog. Fish-Cult., Vol. 18, No. 2, pp. 88-91.

Here are given results of investigations on the incidence of avitaminosis, due to the deficiency of certain vitamins of the B group, among the common carp (Cyprinus carpio Linnaeus) fed a diet of peanut meal plus fish meal. Fish meal comprised 9 percent of the total feed. Symptoms of avitaminosis manifested themselves in about 180 days among the carp fed the above diet at 2.5 and 5.0 percent of the body weight of the fish per day. Two types of avitaminosis were caused. One was characterized by extreme excitability and nervousness of the fish, loss of equilibrium, disintegration of fin membranes, and opaqueness of cornea; the other, by a pop-eye condition. The former type of the disease was cured by injecting intraperitoneally 1 mg. each of a mixture of pyridoxine, calcium pantothenate, and folic acid, or of a mixture of riboflavine, vitamin B_{12}, and choline (choline, 50 mg.). An injection of thiamine, even as much as 5 mg. per fish, did not cure this type of avitaminosis. The pop-eye condition was completely cured by injecting intraperitoneally 1 mg. each of pyridoxine, calcium pantothenate, and folic acid in a mixture. Injecting folic acid or riboflavine alone did not cure or even alleviate this disease. (A)

692. Johnson, Harlan E. 1956. TREATMENT OF TRICHODINID INFECTIONS OF CHINOOK SALMON FINGERLINGS. Prog. Fish-Cult., Vol. 18, No. 2, April, p. 94.

Trichodinid infection of fall chinook salmon fingerlings caused considerable mortality in the fall of 1955. At one hatchery, 400 of 500,000 fish held in 10 raceways died daily. Following treatment of eight of the ponds with formalin at a concentration of 1:4,700 for one hour, and two ponds with PMA, pyridylmercuric acetate, at a concentration of 1:500,000 for one hour, mortalities averaged about five fish per day for the entire lot. At another hatchery, four ponds with 400,000 fingerlings being held over winter were found to be heavily infested with Trichodina. These ponds were treated with PMA at a concentration of 1:333,000 and within five days the mortality dropped to 34 on one day from 1,000 to 1,400 the week before. PMA is more expensive but easier to use than formalin and no danger exists, as it does with formalin, of developing lethal concentrations in areas of ponds.

693. Ohle, Waldemar. 1956. BIOACTIVITY, PRODUCTION, AND ENERGY UTILIZATION OF LAKES. Limnology and Oceanography, Vol. 1, No. 3, July, pp. 139-149.

Because both the cause and the result of organic production have become so closely associated in respect to terminology of lake types that comparison of different lakes has become difficult, it appears desirable to use the intensity of organic production as a basis of comparison, rather than the factors influencing it; and thus return to the original concept stated by the founders of the trophic system. According to this concept all surface waters regardless of their size and of their ecological characteristics can be arranged in a continuous series of increasing trophic level. Oligotrophy, eutrophy, mesotrophy and polytrophy designate approximate magnitude of productivity. A short definition proposed for bodies of water is--"The specific bioactivity (author's substitute term for productivity) of a biosystem is its capacity for the formation of potential energy and the subsequent reconversion of this into kinetic energy per unit time and per unit volume or surface acre." The expression "production" should be reserved exclusively for the various components of bioactivity. Bioactivity consists of indigenous primary production and all secondary productions based upon it as well as upon added organic substances.

A short description of procedure used in determining and calculating carbon dioxide accumulation in tropholytic layers is presented. The results obtained for six north German lakes by use of this method are analysed. It has been found that the magnitude of the "relative assimilation intensity," or primary production, is not dependent on the mean depth of these lakes; but there is a close relation to depth as long as the deep water does not lose all of its oxygen supply in summer time. Factors to be considered and understood in the application of carbon dioxide accumulation to calculations of production biology are discussed. To estimate total bioactivity, the magnitude of primary production and the quantity of utilizable organic compounds furnished the lake

from its environment must first be determined followed by the efficiency of energy utilization.

694. Smoker, William Alexander. 1956. EFFECTS OF STREAMFLOW ON SILVER SALMON PRODUCTION IN WESTERN WASHINGTON. Dissertation Abstracts, Vol. 16, No. 4, April, pp. 638.

In this study the abundance of adult silver salmon, Oncorhynchus kisutch, landed each year in the Western Washington commercial fisheries from 1935 to 1954 was found to be closely correlated with both the annual and low-month average streamflows for Western Washington that occurred during the juvenile residence of the salmon. Catches of silver salmon from certain specific Washington rivers, or near their mouths, did not correlate to a significant extent with the annual or low-month streamflows.

An index for the streamflow by months from 1933 to 1952 in Western Washington was derived by computing the average runoff for 23 major rivers. Annual, summer, monthly, and lowest-month streamflows provided high correlation coefficients with total commercial silver landings except for some of the winter and spring months. The significant correlations of the summer and low-month flows occurred because they are good indices of annual runoff. Both of these low flow variables, however, showed almost borderline significance and are considered at times to have an independent effect on silver salmon production.

Freshets during the incubation period of silver salmon eggs were not found to affect silver yearling production in Minter Creek, but did limit the chum salmon fry production. Total streamflow during stream residence correlated significantly with the production of yearling silver salmon and two-year-old steelhead trout at Minter Creek. The interaction of parent egg deposition with streamflow in the production of silver yearlings was shown by Minter Creek data. Various rainfall data for Washington were found to correlate significantly with total silver salmon landings in Western Washington. (A)

695. Gross, Arthur Lewis. 1956. THE CORRELATION BETWEEN HYDROCHEMICAL ECOLOGICAL FACTORS AND THE QUANTITY OF FISH IN A BLACK BELT AND AN UPPER COASTAL PLAIN STREAM IN ALABAMA. M. S. Thesis U. of Ala., 27 pp.

An Upper Coastal Plain stream was compared with a similar Black Belt stream for quantity of fish, various chemicals, and pH. It was found that the Black Belt stream had significantly more fish, and that it was correlated with calcium content and the pH of the water. (R. L. C.)

696. Hemphill, Andrew Frederick. 1954. A PRELIMINARY SURVEY OF THE FISHES IN THE STREAMS EMERGING FROM THE VICKSBURG BLUFFS, WARREN COUNTY, MISSISSIPPI. M. S. Thesis, U. of Ala., 90 pp.

Twenty-eight species and subspecies of fishes were collected in nine streams between 1951 and 1954. Measurements, tooth, scale, and fin counts are presented, along with distributional and ecological data. Keys for the identification of the fishes are included. (R. L. C.)

697. Limbaugh, Conrad, 1955. FISH LIFE IN THE KELP BEDS AND THE EFFECTS OF KELP HARVESTING. IMR Ref. 55-9, Univ. of Calif., Inst. of Marine Resources, Sept. 9, 158 pp.

An intensive five and one-half year study of the effects of kelp harvesting on fish life was conducted on the extensive kelp beds along the southern California coast. Of the 125 species of fish found in the kelp beds most are wanderers and bottom species completely independent of the kelp itself. Most are inedible and uncommon species, not abundant enough to serve as forage for other fishes. Of the pelagic and semi-pelagic forms associated with the area immediately beyond the kelp beds, the yellowtail and barracuda, prized game fish, are also common where no kelp grows and therefore would not be greatly affected. Certain fishes seek cover in the beds, e. g. the extremely abundant topsmelt and young kelp bass. Their numbers here are insignificant, however, when compared with those found inshore along the bottom. Small organisms forming forage for kelp-bed fishes were found to be present in the canopy as well as at lower depths, even after harvesting. Species of fish most closely associated with the harvested area maintained high population levels. It is concluded that kelp harvesting as presently practiced has no seriously detrimental effects on fishing.

An extensive outline presents the habits of fishes found in the kelp beds and lists the invertebrates and certain marine plants of three biotopes.

698. Laakso, Martin and Oliver B. Cope. 1956. AGE DETERMINATION IN YELLOWSTONE CUTTHROAT TROUT BY THE SCALE METHOD. J. of Wildlife Mgt., Vol. 20, No. 2, April, pp. 138-153.

Fishery studies conducted on cutthroat trout in Yellowstone Lake have required investigation into the technique of age determination by scale reading since growth characteristics differ from those of the same species at lower altitudes. Studies centered around the identification of scales on which the first annulus failed to form.

Cutthroat trout in Yellowstone Lake ascend spawning streams from May to late July. Fry emerge from late June to early September. Scale formation is initiated when the fish are 41 to 44 millimeters in length. Late-hatched fry may not attain this length before the interruption of growth in October, and thus may overwinter without scales or with only a few small scales. As a result, three developmental types of fry occur in the population; fry overwintering in a fully scaled state, fry passing the winter partially scaled, and fry overwintering without scales. Annulus development after the first growing season occurred on

the scales of fingerlings whose scale growth had reached the four-circulus stage. Late-hatched fry with rudimentary scales failed to establish a year mark during their first fall and winter period. These fish with "retarded" scales exhibit annulus formation following their second growing season. The term "retarded scale" is proposed to designate a scale that does not exhibit an annulus after the first growing season, and the word "normal" is applied to a scale which did establish a year mark after one season's growth. Structural criteria have been established for the identification of the two types of scale development. The bases for differentiating the types are: (1) the numbers of circuli before the first annulus; (2) the size of the focus, or first circulus; and (3) the shape and density of the first one or two circuli. Annulus formation begins before May 1 and is usually complete by the middle of June. Spawners appear to initiate scale growth before non-spawners.

Fingerlings taken late in the season and presumed to be in their first year of life included 35 percent of fully scaled individuals. Those which were unscaled comprised 22 percent, and those classified as partially scaled made up 42.7 percent of the collections. Adults sampled from the 1951, 1952, and 1953 fisheries averaged 40 percent normal. (A)

699. Lagler, Karl F. 1956. THE PIKE, ESOX LUCIUS LINNAEUS, IN RELATION TO WATERFOWL ON THE SENEY NATIONAL WILDLIFE REFUGE MICHIGAN. J. Wildlife Mgt., Vol. 20, No. 2, April, pp. 114-124.

In the Saskatchewan and Athabaska River deltas in Canada it has been estimated that approximately 10 percent (about 1,500,000 individuals) of waterfowl production was destroyed by pike in an average year. The primary objectives of this investigation conducted at intervals from 1941 through 1953, were: (1) to determine the nature, extent, and effect of the feeding habits of the northern pike on waterfowl; and (2) to formulate a plan for the management of the northern pike.

Fish and crayfish were by far the most important and most consistently eaten food of 1,841 pike 12 inches or more in length taken by angling or netting. Waterfowl were present in only 3 of 1,218 pike 14 inches long or longer which were collected during the 90-day waterfowl brooding season (percentage frequency of ducklings in this lot of pike was about 0.2). The basis for pike control on the Seney Refuge rests upon the following premise: elimination of each 500 pike "meals" may be expected to result in the saving of the life of a duckling. Unfortunately the frequency with which pike feed is not known so that the "meals" cannot be translated accurately into numbers of pike to be removed. Experiments on periodicity of feeding, for example those of Solman (1945), are too tenuous to be acceptable for use in extrapolation. If, however, each of the pike on the Seney Refuge large enough to eat a duckling, had a meal per day, and if there are as many as 60,000 such fish on the area, some 60,000 meals are eaten daily. Ducklings are available to pike for about 90 days each year on the Refuge. The duck population is thus exposed, in this hypothesis, to a predation pressure of 5,400,000 pike-meal-units per season. The observed incidence of approximately one duckling in each 500 pike opened (of sizes large enough to eat ducklings and all containing some food) might be considered as an incidence of one such bird per 500 meals. This could mean an annual duckling mortality on the area of 10,800.

Of several means of control tried on the Refuge angling had the widest human appeal and appeared to cost least per fish removed. Unless properly restricted, however, it was recognized that angler activity might interfere with waterfowl production as much or more than the pike themselves, by disturbing the parent birds.

700. Hanson, William R. and Franklin Graybill. 1956. SAMPLE SIZE IN FOOD-HABITS ANALYSES. J. of Wildlife Mgt., Vol. 20, No. 1, Jan., pp. 64-68.

Statistical methods are given for finding the sample size required to estimate the food habits of a population under different conditions. The sample size required for one major food is discussed. However, one food can be used to set sample size for all major foods. When dealing with the proportions of animals eating the different materials, the major food which comes nearest to being eaten by 50 percent of the animals will require the largest sample. Therefore, a sample large enough for it will be large enough for other major foods. When dealing with mean volumes eaten the major food eaten in the greatest range in volume by different animals can be assumed to require the largest sample size. Therefore, a sample large enough for it should be large enough for other major foods. Methods of reducing sample size are discussed. (A)

701. Pelgen, David E. 1955. ECONOMIC VALUES OF STRIPED BASS, SALMON, AND STEELHEAD SPORT FISHING IN CALIFORNIA. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 5-15.

The regular postal card survey in conjunction with questionnaires sent to random samples of California striped bass, salmon, and steelhead anglers was utilized to determine their average expenditures per day of angling for these fish in 1953. The average expenditure per angler day is considered a good measure of the economic value of a sport fishery.

Striped bass anglers spent an average of $9.00 per angler-day, salmon anglers spent an average of $16.00, and steelhead anglers spent an average of $18.00. The estimated value for 1953 of the striped bass fishery was $18,000,000; of the salmon fishery, $10,400,000; and of the steelhead fishery $7,380,000. Distribution of expenditures in several categories shows transportation, food and lodging, and services and supplies to be major items totaling more than 82 percent for each

fishery, whereas equipment costs ranged from 10.6 to 16.4 percent. License costs amounted to only about one percent of total expenditures in each case.

The average sizes of fish reported caught by respondents were striped bass, 4.8 pounds; salmon, 12.3 pounds; steelhead, 5.1 pounds. Expenditures expressed in value per pound and per fish were striped bass $2.85 per pound, or $13.66 per fish; salmon, $1.38 per pound, or $16.85 per fish; steelhead, $5.58 per pound, or $28.26 per fish. An estimated 2,000,000 angler-days were spent angling for striped bass in 1953, 650,000 angler-days for salmon, and 410,000 angler-days for steelhead.

702. Skinner, John E. 1955. CALIFORNIA STATEWIDE ANGLING ESTIMATES FOR 1953. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 19-32.

Of the 9,323 postal card questionnaires mailed, which amounts to eight-tenths of one percent of all licensees, 33.5 percent were returned by respondents. To permit comparison with previous surveys, angler and catch estimates for 1953 based on the questionnaires are given in terms of successful anglers rather than total anglers fishing for a given species.

An estimated 530,000 anglers or 44 percent of all licensees caught 22,300,000 trout. This is a 24 percent increase in anglers and a 20 percent increase in trout over the 1951 survey figures. An estimated 640,000 salmon were caught by 110,000 anglers; of this catch 430,000 were taken in the ocean and 210,000 in rivers. This is an increase of 39 percent in anglers and 13 percent in salmon since 1951. The striped bass fishery remained virtually unchanged; 166,000 anglers caught 1,590,000 stripers.

Catches of black bass and catfish showed highly significant increases over the 1951 survey. Black bass catches showed an increase of 81 percent. This is attributable to improved water conditions in Southern California and the 49 percent increase of the number of successful anglers. The catfish catch was 59 percent greater than in 1951, while successful anglers increased 32 percent. Other warm-water species also showed notable increases in both the total catch estimates and numbers of anglers.

An estimated 15,500,000 days were spent angling in 1953, one-third of them for trout. Ocean fishing accounted for 22 percent of the total. The estimates indicate a decline in ocean sport fishing and a corresponding increase in fresh water fishing in 1953.

703. Wooster, Warren S. and Feenan Jennings. 1955. EXPLORATORY OCEANOGRAPHIC OBSERVATIONS IN THE EASTERN TROPICAL PACIFIC, JANUARY TO MARCH, 1953. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 79-90.

Oceanographic results of an experimental fishing expedition to the eastern tropical Pacific early in 1953 are discussed. The discussion is confined to distribution of temperature and salinity. Interpretation of current measurements obtained will be covered in a subsequent paper.

704. Wilson, Robert C. and Bell M. Shimada. 1955. TUNA LONGLINING: RESULTS OF A CRUISE TO THE EASTERN TROPICAL PACIFIC OCEAN. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 91-98.

This report summarizes the results of longline fishing and some of the biological findings of the cruise. Evidence is presented to support the belief that in the eastern tropical Pacific region there are large tunas inhabiting depths well below the surface, whose distribution appears to be influenced by features of the oceanic circulation rather than by the presence of land masses.

705. Juhl, Rolf. 1955. NOTES ON THE FEEDING HABITS OF SUBSURFACE YELLOWFIN AND BIGEYE TUNAS OF THE EASTERN TROPICAL PACIFIC OCEAN. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 99-101.

This report summarizes the results of studies of the contents of 10 stomachs of yellowfin tuna and 5 stomachs of bigeye tuna caught by longline. By volume, 57.8 percent of the total contents of the 15 stomachs was fish; 27.2 percent, squid; and 15.0 percent, crabs. No difference in food preferences of the yellowfin and bigeye tunas was noted, but the data are inconclusive.

706. Iwai, Tamotsu. 1955. THE PHARYNGEAL POCKETS OF THE SARDINE, SARDINOPS CAERULEA (GIRARD). Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 113-116.

Pharyngeal structures of the gizzard shad were compared with those of adult California sardines. This study does not permit any determination of the function of the pharyngeal pockets. A histological study leads to the conclusion that no respiratory function is performed nor has food been observed therein. Through their elasticity, however, they may contribute to the concentration and swallowing of food.

707. Hume, Lloyd C. 1955. RAINBOW TROUT SPAWN TWICE A YEAR. Calif. Fish and Game, Vol. 41, No. 1, Jan., p. 117.

On July 6, 1951, 200 female rainbow trout of a fall-spawning strain imported from Idaho were examined for ripe eggs. Ten had mature eggs and 18 had "water hardened" eggs. The ten fish with ripe eggs and five of those with "water hardened" eggs were stripped and tagged. The three tagged fish remaining in January were spawned again. Most of the group of females from which the tagged fish were taken spawned in June, July, or August of 1951 and again around the first of January 1952. Males, however, did not become ripe in the summer, though they did ripen and produce sperm in the winter.

708. Coots, Millard. 1955. THE PACIFIC LAMPREY, ENTOSPHENUS TRIDENTATUS,

ABOVE COPCO DAM, SISKIYOU COUNTY, CALIFORNIA. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 118-119.

The probability of a land-locked form of the Pacific lamprey is indicated by recent capture of adults above Copco dam on the Upper Klamath River. As this dam, built in 1922, is 126 feet high, it seems extremely doubtful that sea-run lampreys can gain access to the watershed above. The existence of a landlocked race of E. tridentatus ciliatus in Goose Lake, Oregon, was recorded by Hubbs (Mich. Acad. Sci. Arts and Ltrs., Papers, Vol. 4, 1924).

709. German, E. R. and D. A. LaFaunce. 1955. A COMMENT ON THE USE OF RED TAGS ON FISH. Calif. Fish and Game, Vol. 41, No. 1, Jan., pp. 119-120.

Doubt regarding the use of red tags on rainbow trout has been raised by observations of tagged trout in broodstock holding ponds. Abraded areas around red tags of two fish having both white and red tags caused by nipping and striking of other fish of the same age was noted; both fish finally died. Other red-tagged fish not attacked at all or frequently enough to cause harm suggests that "peck order" may have been important. The fact that these fish were more crowded than in nature and were in very clear water obscures any positive conclusion from these observations. However, the possibility that use of red tags introduces a mortality factor not considered heretofore deserves consideration.

710. Junge, Charles O. and William H. Bayliff. 1955. ESTIMATING THE CONTRIBUTION OF A SALMON PRODUCTION AREA BY MARKED FISH EXPERIMENTS. Fisheries Res. Papers, Wash. Dept. of Fisheries, Vol. 1, No. 3, Feb., pp. 51-58.

This paper reviews the usual technique used to determine the contribution of a production area to a fishery by means of marked fish, lists the assumptions inherent in this technique, and presents methods for determining confidence intervals on the parameters involved. For illustration, certain data on recoveries of silver salmon marked in the State of Washington are analyzed.

711. Bonham, Kelshaw and Paul R. Olson. 1956. THE WHITE SEA BASS, CYNOSCION NOBILIS, IN PUGET SOUND. Copeia, No. 1, Feb. 29, pp. 64-65.

A 42-pound white sea bass, Cynoscion nobilis, was captured by hand at the surface in water 15 feet deep off the mouth of the Stillaguamish River on January 21, 1955. This record extends the northward distribution of this warm water fish approximately 100 miles.

712. Beeton, Alfred M. 1956. FOOD HABITS OF THE BURBOT (LOTA LOTA LACUSTRIS) IN THE WHITE RIVER, A MICHIGAN TROUT STREAM. Copeia, No. 1, Feb. 29, pp. 58-60.

Stomach analysis on 196 burbot, 2 to 12.9 inches in length selected from a large series of collections covering the entire White River drainage revealed a positive correlation between food size and consumer size. The sequence generally is insects, gammarids, crayfish, and fish. Stomachs of 176 summer collected fish showed that under 7 inches Gammarus fasciatus and insect larvae and nymphs were eaten most frequently and comprised the greatest percentage of total food volume. For burbot over 7 inches, gammarids and insect larvae were of less importance, while crayfish and fish occurred more frequently. Crayfish was the most important food for the 7.0- to 9.9-inch fish. Fish were definitely the most important food of burbot over 10 inches; blacknose dace and rainbow trout were eaten more frequently than other fish.

Although the winter sample of 20 stomachs was small, analysis does indicate a trend. For burbot in the 4.0- to 6.9-inch length group, insect larvae and Gammarus fasciatus were the important constituents of the winter diet, both volumetrically and by frequency of occurrence. The 7.0- to 9.9-inch burbot fed more on gammarids during the winter, as compared to the preference for crayfish during the summer (noted above). Probably the increased consumption of gammarids during winter occurred because of an unavailability of crayfish. One fish in the 10.0- to 12.9-inch group, collected in winter, contained fish remains.

713. Moore, George A. and William E. Burris. 1956. DESCRIPTION OF THE LATERAL-LINE SYSTEM OF THE PIRATE PERCH, APHREDODERUS SAYANUS. Copeia, No. 1, Feb. 29, pp. 18-19.

The lateral line system in 110 specimens of the pirate perch was studied by injection of the canals with india ink; dissection; microtome sections, cut from tissue blocks embedded in celloidin, and stained with Mallory's connective tissue stain and haematoxylin and eosine; skins stained with borax carmine; and by means of a binocular microscope and an air jet. The pattern and structure of cutaneous organs of the cephalic region are described in detail and depicted in plates.

714. Allen, George H. 1956. AGE AND GROWTH OF THE BROOK TROUT IN A WYOMING BEAVER POND. Copeia, No. 1, Feb. 29, pp. 1-9.

This paper presents information on a relatively undisturbed brook trout population in a small Wyoming beaver pond. Methods of determining age by examining scales and opercular bones are described, and length-weight relationship, rate of growth, fecundity, and age at maturity are discussed and are illustrated by figures, tables, and formulas.

715. Roppel, Alton Y. 1956. PEAK HOURS OF PINK (ONCORHYNCHUS GORBUSCHA) AND CHUM (O. KETA) SALMON FRY MIGRATION FROM OLD TOM CREEK, S. E. ALASKA, 1952. Copeia, No. 2, May 29, pp. 110-111.

Old Tom Creek is situated on the east coast of

Prince of Wales Island at a point midway between the entrance of Kasaan Bay and its head. Since most downstream migrants confine their migration to the hours of darkness, this experiment was designed to establish the period of the night during which the fry move in the greatest numbers. Both pink and chum salmon fry emerge from the gravel of Old Tom Creek in April, May, and June and immediately begin their seaward migration. The pinks reach peak migration between May 15 and 30 while the chums peak a month later. Fyke nets with mouth diameters of 12 inches and lengths of 3 feet were used to trap fry as they moved downstream to the sea.

Significant migration began after 10:00 p.m. and small catches of both species were removed at 11:00 p.m. The catch at midnight showed and increased movement with the migration reaching a peak between midnight and 1:00 a.m. Between 1:00 a.m. to 2:00 a.m. the catch lessened, and at 2:00 a.m. the last hourly inspection was made. There was relatively little movement between 2:00 a.m. and 8:00 a.m.

Whereas Pritchard's work on McClinton Creek showed constant rates of seaward migration throughout the hours of darkness migration on Old Tom Creek exhibited a definite nightly peak which apparently was unaffected by changes in light intensity resulting from moonlight or overcast.

716. El-Zarka, Salah. 1956. BREEDING BEHAVIOR OF THE EGYPTIAN CICHLID FISH, TILAPIA ZILLI. Copeia, No. 2, May 29, pp. 112-113.

Tilapia is found in the Nile and its tributaries as well as in the Nile Delta lakes. In Egypt there are several species of the genus but, of these, only Tilapia zilli, Tilapia nilotica, and Tilapia galilea are of primary economic importance. All three species are extremely resilient, especially T. zilli which is euryhaline and can stand a salinity as high as 29 parts per thousand. Although the other two species can live in brackish water, they cannot survive in such highly saline water.

There are two distinct breeding habits among the species of Tilapia in Egypt: some carry the eggs in their mouths during the whole period of development; others lay their eggs in nests and guard them until they hatch. It is generally agreed that T. nilotica and T. galilea have the first type of breeding habit. But there is no such general agreement as to T. zilli. Observation of paired T. zilli refutes the suggestion that this species is a mouth breeder. Nests were built and eggs and fry were guarded until the yolk sac was absorbed. Three broods from one pair were followed. The three spawnings took place on June 9 at a water temperature of 75° F; July 2 at 80° F; and August 27 at 82° F. It is tentatively concluded that there is a positive correlation between water temperature and the number of broods within the breeding season.

717. Strawn, Kirk and Clark Hubbs. 1956. OBSERVATIONS ON STRIPPING SMALL FISHES FOR EXPERIMENTAL PURPOSES. Copeia, No. 2, May 29, pp. 114-116.

Techniques developed for the stripping and care of eggs of small fishes, darters, logperch, redhorse shiner, etc. are described. Advantages of planned crosses, known age of eggs, and other controllable factors outweigh the lower rate of fertilization of stripped eggs compared to naturally fertilized eggs.

718. Miller, Robert Rush. 1956. PLASTIC BAGS FOR CARRYING AND SHIPPING LIVE FISH. Copeia, No. 2, May 29, pp. 118-119.

Plastic bags made of polyethylene allow air to enter while retaining water. Plastics are generally poor conductors of heat and thus protect against temperature changes more effectively than do metal containers. When properly insulated, plastic bags maintain their temperature with remarkably little fluctuation over a period of many hours, even under subzero conditions.

Single-thickness bags (24 x 18 inches, capacity about 5 gallons) after being filled with air and 2 gallons of water and secured tightly at the neck are placed in single-ply cardboard boxes insulated with corrugated cardboard liner. Pure oxygen may be used to inflate the bag. The number of fish accomodated can be increased by adding one-half to one grain of sodium amytal per gallon of water. Fishes treated have been kept for one week with no visible damage and only one-third the ordinary amount of water is needed. A double thickness bag with a bottom 15 x 15 inches square and 23 inches high, inflated with oxygen and with 4 inches of water safely carries 75 large mollies or 300 gambusias up to 36 hours.

719. Tanasiichuk, V. S. - A VOLUMETRIC METHOD OF QUANTITATIVE ESTIMATION OF YOUNG FISH. Zoologicheskii Zhurnal, Vol. 31, No. 4, pp. 620-633. (English translation by W. E. Ricker, Pac. Biol. Sta., Nanaimo, B.C.)

The kind of volumetric census of young fish of the North Caspian Sea proposed in this paper is still not completely satisfactory and needs further improvement: the use of an encircling type of fishing gear and a determination of the fishing efficiency of such gear will make possible a closer approximation to an absolute census. Nevertheless, in addition to providing a relative estimate of the size of the different year-classes even when the years are separated from each other by a long period of time, this method makes it possible to approach an understanding of the dynamics of the survival of young in different years and in some degree to reveal the causes of these dynamics. The direct relationship which has been noted between survival and growth of the young fish, and also the effect of the wider regime on survival of the young, opens further perspectives for scientific investigation which will assist in the solution to the question of increasing survival of young. The solution of this question must proceed in two directions: (1) study of the place and conditions of wintering of the young fish and development of measures to improve wintering conditions; (2) study of the

causes which determine variations in growth of young in the sea; this question is being worked upon at the present time and requires further close study. (A.)

720. Kerswill, C. J., Dr. 1956. A SURVEY OF THE 1955 SCARCITY. The Atlantic Salmon J., No. 1, Feb., pp. 23-24.

In 1955 the research program of the Federal-Provincial Co-ordinating Committee on Atlantic Salmon included (a) an analysis of detailed statistics on commercial and angling catches for the 1955 season for comparison with those of previous years; (b) further study of the survival and growth of young salmon from fertilized eggs to smolts in typical areas; (c) continued analysis of the utilization of salmon produced by several rivers on which descending smolts are marked annually by fin-clipping; (d) special study of the effects on young salmon and the stream insects on which they feed, of recent sprayings with DDT against budworms in the woodland of northern New Brunswick and the Gaspe Peninsula.

The 1955 season was disappointing for most commercial fishermen in the Maritime Provinces and Newfoundland, as well as to many anglers. The explanation of the scarcity of salmon in 1955 in commercial fishing areas of the Miramichi, and likely of other areas, according to the surveys made apparently lies in water conditions associated with the unusually hot, dry weather of the summer of that year. The lack of freshets and the unbroken high estuarial water temperature of 1955 was not conducive to movement of salmon so they avoided the netting areas until the onset of cool fall weather and autumn rains. Since 1945 the average annual temperature of the North Atlantic has been above normal, and reached a peak in 1951, the highest since such records started in 1921, and about 3 degrees F. above normal.

The spraying of woodland in the Miramichi area with DDT in 1954 had drastic effects on young salmon in sprayed areas, not because they starved, although the water insects on which they feed were affected also. Parr were very scarce in the sprayed areas, as confirmed by the annual census in August 1955, while fry were unusually abundant. Some recovery of the stream insects in the sprayed areas has been observed in 1955, but the composition of the insect population as a whole is considerably different from the insect population in unsprayed areas. However, feeding conditions for fry hatched in 1955 have been suitable for good survival and growth.

721. Serventy, D. L. 1956. THE SOUTHERN BLUEFIN TUNA, THUNNUS THYNNUS MACCOYII (CASTELNAU), IN AUSTRALIAN WATERS. Aust. J. of Mar. and Freshwater Res., Vol. 7, No. 1, April, pp. 1-43.

This paper deals with the results of the investigations of the Division of Fisheries, C.S.I.R.O., into the biology of the southern bluefin tuna (Thunnus thynnus maccoyii (Castelnau)), a representative in southern Australia and New Zealand of the tunny of Europe and the bluefin tuna of California.

A comparative description of the morphology of the Australian form is given with a detailed study of its occurrence in Australia, including a discussion of the possible presence of local breeding stocks. The growth rate is considered from a study of length frequency data. Considerable variations have been found in the growth rate of the younger age classes, as well as fluctuations in their relative abundance and their migratory movements along the eastern Australian coastline. Reference is made to the feeding habits in various areas. (A)

722. Serventy, D. L. 1956. ADDITIONAL OBSERVATIONS ON THE BIOLOGY OF THE NORTHERN BLUEFIN TUNA, KISHINOELLA TONGGOL (BLEEKER), IN AUSTRALIA. Aust. J. of Mar. and Freshwater Res., Vol. 7, No. 1, April, pp. 44-63.

The northern bluefin tuna, Kishinoella tonggol (Bleeker), occurs along the whole of the north coast of Australia and on the east and west coasts as far south as Twofold Bay, N.S.W., and Cockburn Sound, W.A., respectively. Fin formulae, scale row and gill-raker data, and morphometrical characters are recorded separately for fish of the northern, eastern, and western regions. Marked regional differences occur; but it is considered that these can be largely (though not entirely) explained by differential growth of body parts, since only small sizes are found in the extreme north, whereas large sizes predominate in the southern portions of the range. The hypothesis of two distinct species, suggested by size group distribution and regional variations, is rejected. Sexual maturity in K. tonggol is reached in the third year of life and spawning is in the summer. The species apparently feeds mainly on pelagic organisms. (A)

723. Pruginin, J. 1956. ERADICATION OF COARSE VEGETATION IN FISH PONDS. Bamidgeh (Bull. of Fish Culture in Israel), Vol. 8, No. 1, Jan., pp. 10-12.

This article deals with methods of eradication of plants which grow along the banks of ponds, or which spread from the banks into the shallow areas which are less than 50 cm. deep. In this group belong: Inula viscosa (L), Phragmites sp., Typha sp., etc. The customary methods in Israel are mainly mechanical and partly chemical; neither has solved the problem. Coordinated chemical and biological extermination seems to produce the best effect. "Biological extermination," is the deterrence or prevention of the spreading of harmful vegetation by replacing it with desirable vegetation and giving over the entire area to constant pasturage by cattle. The goal must be the destruction of the existing vegetation and the prevention of new growth by blanketing the areas which have been cleared with desirable vegetation capable of preventing the renewal of undesirable vegetation. Such a plant is the "Kikuyu grass" (Pennisetum

clandestinum), which provides excellent pasturage. The process of replacing harmful vegetation with beneficial is carried out in two stages: (a) eradication of existing vegetation by spraying broad-leaved plants with 2,4-D, and narrow-leaved with "Dalapon," and (b) planting "kikuyu-grass." Caution must be exercised in introducing new plants, and only such vegetation over which there is certain control should be used.

724. Allen, George H. 1956. FOOD OF SALMONID FISHES OF THE NORTH PACIFIC OCEAN (Food of Sockeye Salmon (O. nerka). Fishery Rep. No. 1, Dept. of Oceanography, Univ. of Wash., Feb., 23 pp., ditto.

Results of examination of the stomach content of 333 sockeye salmon (O. nerka) caught in the Japanese high seas fishery and experimental gillnet fishing in areas south of the Aleutian Islands from May 18 to September 13, 1955, are presented. Most fish were from the Japanese fisheries, with samples originating from 20 areas grouped into three regions: the Sea of Okhotsk, east of Kamchatka, and the open ocean south of the Island of Attu. The remainder were from south of the Aleutian Islands to the east of Attu.

The average volume of the stomach contents for all fish for each of the 20 areas was from 0.4 to 21.4 milliliters; the average volume for stomachs which contained material in measurable amounts for each of the areas was from 2.0 to 25.5 milliliters; and the maximum volume of stomach contents from any single fish for each of the areas was from 2.0 to 100.0 milliliters. The relative number of female salmon with empty stomachs was lower in the open ocean and higher in the Sea of Okhotsk. The relative number of male fish with empty stomachs tended to be constant between regions. Organisms eaten by the salmon were reported as copepods, amphipods, euphausids, pteropods, fish, squid, crustacean larvae, and shrimp. Size of food forms ranged from less than 1 millimeter in over-all length for crustacean larvae and smaller amphipods to over 20 millimeters for amphipods and euphausids. Fish up to 14 centimeters long and a few shrimp about 5 centimeters long were present. Dominant forms eaten by the sockeye, both by volume and frequency of occurrence, were amphipods in the Sea of Okhotsk and east of Kamchatka, and copepods and euphausids in the open ocean. Regional variation occurred in the items of minor importance in the diet. Crustacean larvae were relatively more abundant in the diet of the salmon caught in the Sea of Okhotsk and east of Kamchatka, and copepods and euphausids in the open ocean. Regional variation occurred in the items of minor importance in the diet. Crustacean larvae were relatively more abundant in the diet of the salmon caught in the Sea of Okhotsk and east of Kamchatka, while in the open ocean, amphipods, fish, and squid were relatively more abundant. Pteropods were of frequent occurrence, but of slight volume, in the diet of salmon from all areas. Fish from the same area were found feeding on different food items and many stomachs showed change in food along the length of the stomach. This strongly indicates that the fish were feeding on local concentrations of the forms, and that patchiness of plankton forms is related to the feeding of sockeye salmon. Preliminary comparison between plankton samples and stomach contents indicated the need for new plankton sampling gear and techniques if the distribution and abundance of organisms serving as food of the salmon are to be studied successfully. (A)

725. Liebmann, H. 1956. MALNUTRITION AND DEGENERATION AS THE PRIMARY CAUSES IN INFECTIOUS DROPSY IN FISH. (Ernahrungsstorung und Degeneration als Primare Ursache der Bauchwassersucht Bei Fischen.) Berliner und Munchener Tierarztliche Wochenschrift for 1956, p. 21 (the available reprint has 14 pp. 1-14).

Infectious dropsy, known for a long time but only in 1930 named and described in detail as Pseudomonas punctata, has become common among trout and is causing heavy losses particularly in rainbow trout in Germany and surrounding countries. Symptoms have changed (in Germany) from the dropsical condition which is now rare to more frequent superficial ulcerations. Research conducted at the Willenbach Institute furnishes increasing evidence that susceptibility of fish during recent years has increased due to artificial feeding and overcrowding. Also, breeding strains of carp for customer appeal rather than resistance to infection is of great importance. Bavarian investigators are finding evidence that malnutrition and hereditary factors are of greater importance than the pathogen in outbreaks of this disease. Disinfection of ponds with at least 25,000-30,000 pounds of quicklime per acre is recommended for immediate control. Best results are obtained by leaving 5-10 inches of water in the pond during disinfection. (S. F. S.)

726. Paulát, F. and M. Paulát. 1955. PŘÍSTROJE PROTI ZAMRZÁNÍ PROHLUBNI NA KOMOROVÝCH RYBNÍCÍCH (A device to prevent freeze-up of an opening in ponds). Sborník Československé Akademie Zemědělských Věd Živocisna Výroba, Ročník XXVIII, Číslo 5, pp. 357-362, illus. (The Annals of the CAAS the Series Animal Production and Veterinary).

Mechanical devices invented by the authors have replaced hand methods for maintaining openings in ice-covered ponds. The principle of operation employs wind or water power to agitate and/or circulate water. One model consists of a small bucket-type waterwheel installed near the bottom of the outlet pipe. Power is transmitted through a vertical shaft and geared to rotate a horizontal crossarm estimated to be 3 to 4 feet in length. Fin-type blades at the ends move through the water and furnish agitation. A second type employs a small water-driven axial turbine connected with the outlet but situated some distance away. The vertical shaft moves an agitator similar to the one described, but in addition a small propellor is mounted below the surface so that its movement circulates water from the bottom towards the

surface. The third device consists of a small windmill supported on metal bouys and moored to a stake. Geared to a vertical shaft, it operates a small propellor located below the surface. Photographs show an estimated 10- to 12-foot opening maintained in an ice and snow-covered pond by an 8-blade windmill with an estimated diameter of 3 to 4 feet. Over-all height is estimated at from 6 to 8 feet. (Abstract prepared from German summary). (K. W.)

727. Coil, William H. 1955. RESEARCH NOTES, GROWTH AND VARIATION IN CATOPTROIDES LACUSTRI LOEWEN, 1929. The J. of Parasit., Vol. 41, No. 1, Feb., pp. 113-114.

While removing trematodes from fish caught in gill nets in Lake Erie, Ottawa County, Ohio, mature specimens were noted to exhibit considerable variation in body size. This species, in the light of present evidence, is identified as Catoptroides lacustri. Confusion concerning the species in the genera Phyllodistomum and Catoptoides, prompted this preliminary investigation of the problem of growth and variation in the species at hand. Measurements and other descriptive material presented are based on 103 specimens collected from 36 live channel catfish.

728. Korschgen, Leroy J. and Don L. Moyle. 1955. FOOD HABITS OF THE BULLFROG IN CENTRAL MISSOURI FARM PONDS. Reprint from The Amer. Midland Nat., Vol. 54, No. 2, Oct., pp. 332-341.

Data were obtained from the examination of 455 stomachs of bullfrogs collected from farm ponds between the inclusive dates, April 11, 1950, to October 21, 1951. Food habit data were obtained for almost the entire period that bullfrogs were not in hibernation in Missouri, March through October. The data, presented as monthly and seasonal percentages, revealed definite changes in feeding habits throughout the year. Principal foods consumed closely parallel availability, with noted exceptions.

A total of 82 animal and 33 plant foods were identified in the stomach contents. Principal foods, by major group, with percentages by volume, were as follows: Insects, 32.6 percent; crayfish, 26.4; frogs, 11.1; tadpoles, 10.4; meadow mouse, 3.0; fish 2.8; birds, 2.2; snails, 2.1; toad, 2.0; miscellaneous invertebrates, 1.9; and snapping turtle, 1.0. Plant materials, consisting mainly of unclassified vegetative parts, leaf fragments, and filamentous algae, were found in 53.8 percent of the stomachs examined, and comprised 3.0 percent of the total volume of stomach contents. Plant materials, nevertheless, were considered to have been taken accidentally with animal foods.

729. Barraclough, W. E. and W. W. Johnson. 1956. A NEW MID-WATER TRAWL FOR HERRING. Bull. No. 104, Fish. Res. Bd. of Canada, 25 pp.

Plans and details of construction and operation are given for a one-boat, two-warp, mid-water trawl designed for fishing herring at depths up to 50 fathoms, by boats of 150-175 h.p. The net, built of nylon, is spread by specially designed, curved, dual-fin otter boards, attached at the ends of "pennants" which are 10 fathoms long to minimize the scaring of herring schools from in front of the net. The lower edge of the mouth of the net is held down by depressors and the upper edge is elevated by planing floats; in operation the mouth of the net opens almost to its full extent. Design details are given for the net, depressor plate, and otter board. Setting, hauling, and fleeting (recovery) of net are described. The refinements achieved may be of practical application in utilizing small otter trawls for fish population sampling.

730. Schumacher, George J. 1956. A QUALITATIVE AND QUANTITATIVE STUDY OF THE PLANKTON ALGAE IN SOUTHWESTERN GEORGIA. Reprint from the Amer. Midland Nat., Vol. 56, No. 1, July, pp. 88-115.

Qualitative collections were limited to 11 counties of southwest Georgia, whereas the quantitative samples were restricted to 15 ponds. A total of 399 species and varieties, 93 genera and 31 families was determined. Two hundred and seven species represent new records for the State of Georgia and 85 species are reported for the first time for the Southeastern Coastal Plain. Some of the more noteworthy finds are Chrysopyxis bipes, Coelastrum chodati, Dinobryon divergens, Peridinium limbatum, Phymatodocis nordstedtiana and Pleurotaenium spinulosum. The qualitative findings are presented in an annotated list, while the quantitative results are recorded graphically by months for each pond. Blooms of Dinobryon divergens and Microcystis aeruginosa were noted during the winter and summer months, respectively.

An attempt was made to classify the 15 ponds surveyed on a basis of the number and variety of algae found therein, with particular emphasis being placed on the Desmidiaceae. This resulted in the establishment of three groups. Group one was characterized by having limited quantitative numbers of algae, a rather even seasonal distribution and a wide variety of species, especially among the desmids. The second group likewise possessed a large variety of desmid species but had a phytoplankton population which was generally rich in numbers exhibitng marked seasonal pulsations. The final group has the intrinsic property of being desmid-poor while having relatively high numbers of diatoms and blue-greens. Members of group three had clear cool waters and sandy bottoms, whereas those ponds in groups one and two had warm dark waters and mucky organic bottoms.

731. Burden, Charles E. 1956. THE FAILURE OF HYPOPHYSECTOMIZED FUNDULUS HETEROCLITUS TO SURVIVE IN FRESH WATER. Reprint from Biol. Bull., Vol. 110, No. 1, Feb., pp. 8-28.

Hypophysectomy results in a loss of ability of the euryhaline cyprinodont, Fundulus heteroclitus, to survive in fresh water. The average survival time is 6-7 days for salt water-adapted fish.

Preadaptation in fresh water before operation may prolong survival but does not prevent ultimate death.

Hypophysectomized fish are unable to survive in salinities up to 13 ppm. Symptoms of death are those of asthenia accompanied by a slight weight increase, averaging 4.3 percent in fish not being handled daily. Serum chloride determinations showed that normal fish in either fresh or salt water maintain a uniform level of ca. 0.886 gm. percent NaCl. Serum of hypophysectomized fish in salt water is not significantly lower (ca. 0.817 gm. percent). Hypophysectomized fish dying in fresh water have only ca. 0.383 gm. percent. Replacement therapy with Fundulus pituitary brei enabled hypohysectomized fish to survive in fresh water. Pituitary extract from Perca flavescens, a strictly fresh water species, was partially effective, whereas extracts from glands of Pollachius virens, a marine species, had no beneficial influence. Injections of ACTH, GH, TSH, thyroxin, DOCA, posterior lobe extract, and an ACTH-GH-TSH combination failed to enable the fish to survive in fresh water.

The data presented above appear to indicate that the pituitary of F. heteroclitus secretes an unknown factor(s) which regulates salt balance in that fish in fresh water. This factor is apparently lacking in the stenohaline marine species, P. virens, but may be present in the fresh water species, P. flavescens.

Hypophysectomy has no effect on the cytology of the chloride cells either in the active (sea water) or regressed (fresh water) condition. Mucous cells were more abundant in the gills of normal fish when adapted to fresh water than when adapted to salt water. Hypophysectomy resulted in atrophy of the mucous cells in either medium and a decreased abundance in fish dying in fresh water. The abundance and condition of the mucous cells was restored to normal in hypophysectomized fish which were induced to survive in fresh water by injections of Fundulus pituitary brei. The data suggest that the chloride cells are not concerned in the failure of hypophysectomized fish to survive in fresh water, but that atrophy of the mucous cells may be involved. (A)

732. Pyefinch, K. A. 1955. A REVIEW OF THE LITERATURE ON THE BIOLOGY OF THE ATLANTIC SALMON (Salmo salar Linneaus). Scottish Home Dept., Freshwater and Salmon Fish. Res. Rep. #9, Her Majesty's Stationery Office, Edinburgh. 24 pp.

This paper is divided into the following categories for discussion: scale reading; marking and tagging; spawning and behaviour of the newly hatched alevin; biology of salmon parr; smolt development and migration; the sea phase; upstream migration; fishways and barriers; kelts; predators and parasites; and a summary and discussion of the advances and, in some cases, lack of advances in the investigations of the life history of the Atlantic salmon.

733. Murphy, Garth I. and Isaac I. Ikehara. 1955. A SUMMARY OF SIGHTINGS OF FISH SCHOOLS AND BIRD FLOCKS AND OF TROLLING IN THE CENTRAL PACIFIC. Spec. Scientific Rep.--Fish. No. 154, U. S. Fish & Wildlife Service, June, 19 pp.

From October 1950 to April 1953, surface trolling and bird and fish watches were maintained on Pacific Oceanic Fishery Investigation vessels in the central Pacific. These observations have been separated into "island" (0 to 60 miles from land), "semioceanic" (60 to 180 miles from land), and "oceanic" (more than 180 miles from land) provinces. The seasonal pattern of frequency of daily sightings in the Hawaiian Islands area closely resembles the seasonal pattern of landings of the commercial tuna fishery. The frequency of fish sightings appears to be related to the abundance of birds. The seasonal patterns in the Hawaiian, Line, and Phoenix Islands are similar, with greater frequency of sightings during the period June to November. Skipjack dominate the surface schools in the Hawaiian area, and yellowfin dominate in the Line and Phoenix Islands.

The frequency of sightings in semioceanic areas is approximately the same as in the island areas, while the frequency of sightings in the oceanic areas in general was lower than in island and semioceanic areas. Skipjack are evidently the dominant surface tuna in the oceanic and semioceanic areas, and surface yellowfin, if not dominant, at least are relatively more abundant close to land. There is an indication of seasonality in the abundance of surface schools in the oceanic area, probably differing from the seasonal pattern in island and semioceanic areas. Trolling indicated a relatively high abundance of tunas, particularly yellowfin, in the near proximity of islands, with a uniformly low abundance in the semioceanic and oceanic areas.

The evidence indicates that the abundance of surface schools near islands in the central Pacific is a function of the standing crop of plankton. In the oceanic area the abundance of surface schools and birds does not closely parallel the abundance of plankton. (A)

734. Shomura, Richard S. 1955. A COMPARATIVE STUDY OF LONGLINE BAITS. Spec. Scientific Rep.—Fish. No. 151, U. S. Fish & Wildlife Service, June, 34 pp.

A study of longline bait returns conducted in the equatorial Pacific south of Hawaii shows a progressive decrease in the number of sardine baits retrieved with increasing time in the water. With respect to sardine, there were no differences in catches as between salted and brined or between salted and fresh-thawed baits. Of the three principal bait species studied (sardine, herring, and squid), the evidence shows the sardine to be the best longline bait. The sardine need only be single hooked, whereas the herring in order to attain equal efficiency must be double hooked. The sardine's superiority over squid is based on

higher catches in moderate to rough seas. If this advantage is due to visibility, then the herring, which is similar in appearance to the sardine, should also be superior to the squid in rough seas, providing the herring are double hooked. Thus, the order of preferability of the commonly available longline bait is single-hooked sardines, double-hooked herring, and finally squid. Differences in the catch related to the kind of bait are not attributable to dietary preference, but are explained on the basis of availability or visibility. It is unnecessary to make adjustments to the catches made by the different species of bait and different baiting methods for general study of tuna abundance in the equatorial Pacific, because the differences in catch were small in magnitude when contrasted with other sources of variability.

735. Starrett, William C. and Paul G. Barnickol. 1955. EFFICIENCY AND SELECTIVITY OF COMMERCIAL FISHING DEVICES USED ON THE MISSISSIPPI RIVER. Bull. of the Ill. Nat. History Survey, Vol. 26, Art. 4, July, 41 pp.

Data on fishing with various types of commercial fishing devices collected during a fish survey of the Mississippi River between Caruthersville, Missouri, and Dubuque, Iowa, in 1944 and 1946 are analyzed statistically to determine the efficiency and selectivity of the devices used. During the survey, the following types of commercial fishing devices were used: seines, trammel nets, basket traps, wing nets, hoop nets, trap nets, and trot lines.

Twenty-five seine hauls were made by the survey crew with 1-inch-mesh seines of 100-, 150-, and 200-yard lengths. Carp, buffalo fishes, channel catfish, paddlefish, carpsuckers, and fresh water drum were the principal commercial species taken with seines. Shortnose gar was the principal predatory fish, gizzard shad the principal forage fish, and white crappie the principal sport fish. Sport fishes amounted to 11.7 percent by number and 3.3 percent by weight of the total catch with seines. Crappies comprised 82.1 percent of the number of sport fishes taken with seines. Of the fish taken in the survey with basket traps, 80.8 percent were catfishes, 15.1 percent were shortnose gars. No sport fish was taken in the basket traps.

One-inch-mesh wing nets with leads were found to be more efficient in taking crappies, bluegills, and buffalo fishes than were nets of the same mesh fished without leads. The efficiency of wing nets in taking sport fishes decreased as mesh size increased. Wing nets took more sport fishes per net-day than did hoop nets.

The catch of fresh water drums of commercial sizes was larger per net-day in the 2 1/2-inch-mesh hoop nets than in the 2 1/2-inch-mesh wing nets. The catch of buffalo fishes of commercial sizes was slightly larger in the 2 1/2-inch-mesh wing nets than in the 2 1/2-inch-mesh hoop nets. The 2 1/2-inch-mesh hoop nets were the most effective entrapment devices used for flathead catfish of commercial sizes.

Three trammel net sets were made on a selective basis for carp and buffalo fishes. Trammel nets having an inner net of 1 1/2-inch mesh took a larger number of sport fishes than did trammel nets having inner nets with mesh sizes of 2 or 3 inches. Trammel net float fishing was found to be selective for shovelnose sturgeon and freshwater drums. Only five sport fishes were taken by this method of trammel netting.

In 27 experimental trammel net sets at Grafton, 15.2 percent of the fish taken in the section with an inner net of 1 1/2-inch mesh were gilled; 19.7 percent taken in the section with an inner net of 2-inch mesh, and 9.1 percent taken in the section with an inner net of 3-inch mesh were gilled. No white crappie was gilled. In the section with the 1 1/2-inch-mesh inner net, 15.1 percent of the black crappies were gilled; in the section with the 2-inch-mesh net 30.8 percent of the black crappies were gilled. Of commercial species taken, buffalo fishes had the greatest tendency to become gilled.

In 33 experimental trammel net floats made at Quincy, 4.2 percent of the fish taken in the section of the net with a 1 1/2-inch-mesh inner net were gilled; 5.6 percent in the section with a 2-inch-mesh inner net were gilled. (A)

736. Smith, Roland F. and Richard W. Gross. 1955. AN EVALUATION OF THE FIFTEEN-INCH MINIMUM SIZE LIMIT ON PICKEREL IN THREE NEW JERSEY LAKES. Misc. Rep. No. 15, New Jersey Fisheries Laboratory, Dept. of Conservation and Economic Development, 20 pp.

From 1950 through 1955, seven lakes in northern New Jersey were studied to determine the effect of a 15-inch experimental size limit on pickerel. Three of these lakes had this size limit imposed in 1951; the other four control lakes had the more general 12-inch size-limit restriction. Under conditions encountered, the 15-inch size limit failed to increase the average size of legal pickerel, and did not make more pickerel available in two of the 15-inch lakes. Ice-fishing harvest from the third 15-inch lake more than doubled in recent years but this cannot be directly related to the larger size limit due to the significant increase in the number of anglers. Moreover, the 15-inch limit did not permit efficient harvest of the available crop in those lakes with mediocre pickerel growth. For one lake with better than average growth, data suggest the possibility that more fish less than 15 inches were produced after the 15-inch limit was put into effect than before, but that if this actually occurred, their slower growth rate in 1955 has tended to keep their mass weight at a satisfactory level. No increase in size of standing crop has been demonstrable.

Tagging studies indicate that sublegal pickerel are extremely vulnerable to all types of gear and may be caught repeatedly. Sufficient information is not on hand to warrant conclusions concerned with hooking mortality. Regulations to maintain a pickerel population at a "safe" density level appear necessary only on lakes fished heavily. Neither the criteria for a heavily fished lake nor the type regulation needed have been established.

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